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VOL. X, 1907

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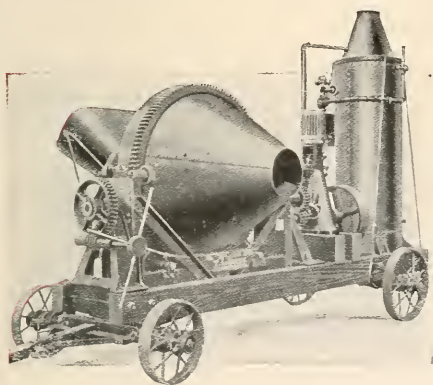
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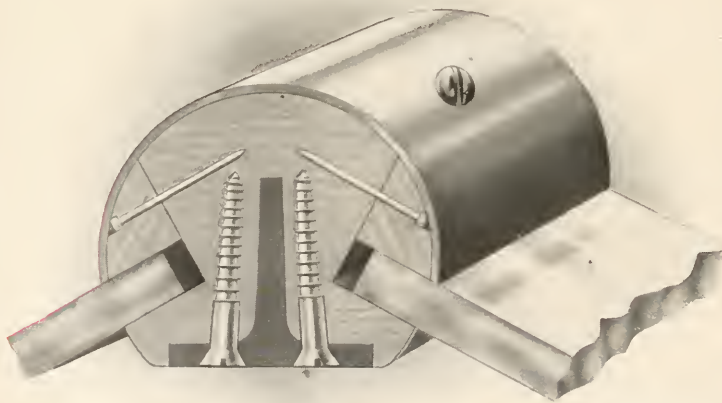
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PUBLISHED UNDER THE AUSPICES
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1907

TENTH YEAR

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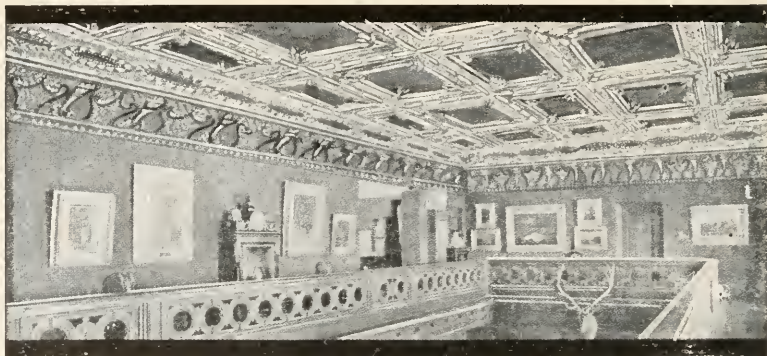
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Preface



THIS little reference book lays claim to the right for existence on the ground that it contains collated between its covers information of particular and special value to architects, builders and engineers doing business in the State of Illinois.

As over seventy-five per cent. of all the architects licensed to practice in this state do business in the City of Chicago, particular attention is given to Chicago laws and practice. In this, the tenth annual edition, much new matter has been added. All the tables, formulas, and other useful information have been carefully revised and re-arranged, as near as possible according to the Dewey system of classification, a system which is most generally in use, for the classification of technical information, in the more advanced architects' and engineers' offices, and public libraries.

The Building Ordinances of the City of Chicago, as passed in March, 1905, are now republished, with all of the amendments which have been added to the time of going to press. Heretofore there has been much confusion owing to the fact that the Building Ordinances, as published by the authorities of the Building Department, were numbered by sections as contained in the Building ordinances preceding the passage of the Municipal Code of the City of Chicago, and that in consequence, while the matter contained is practically the same, the old section numbers did not correspond with the Municipal Code numbers and were not legal reference numbers. We have heretofore published the section numbers with reference to the Code numbers at the bottom of the page. This year we abandon the section number altogether and publish the correct legal Municipal Code number.

Owing to the lack of space, only the amendments to the Sanitary Ordinances of the City of Chicago are published. For the complete Sanitary Ordinances, see 1906 edition of this Handbook.

Prof. N. Clifford Ricker, of the University of Illinois, presents new information regarding cast iron base plates for columns, as a result of the last year's experimentation.

Prof. Arthur N. Talbot, also of the University of Illinois, gives imperial formula and rules for the design of reinforced concrete. Prof. Talbot is probably the best known disinterested authority on reinforced concrete construction.

We publish plates containing a revised system of proportioning the architectural orders, the result of the investigation of Mr. Alfred W. S. Cross, M. A., F. R. I. B. A., and Mr. Alan E. Munby, M. A. Also a complete system of nomenclature for drawings and the Dewey Index for classification of information regarding buildings.

Our friends have given us many valuable suggestions for the improvement of the Handbook, which we gratefully acknowledge.

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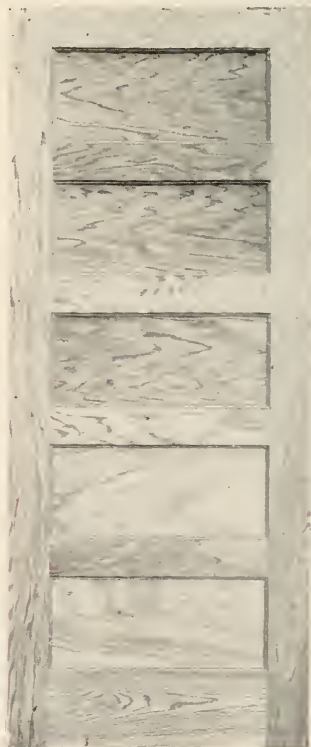
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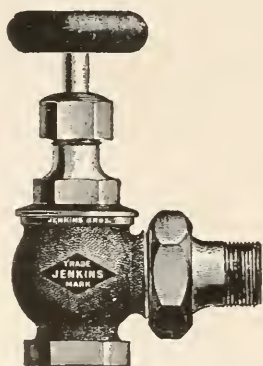
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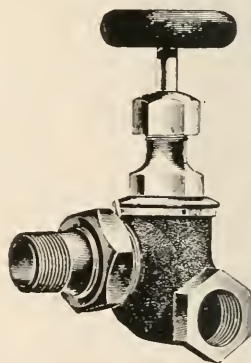
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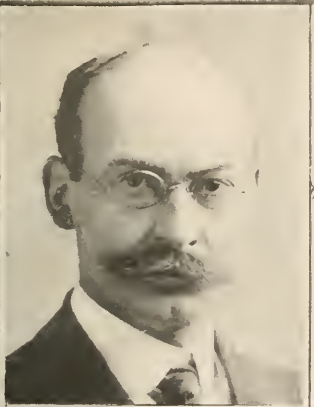
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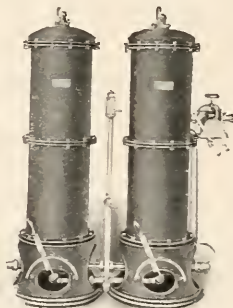
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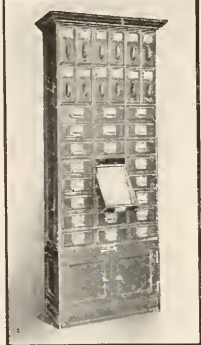
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Organized, January 12, 1897. Incorporated, June 25, 1897.

The year just completed has been fraught with many changes in the line of improvement for the benefit of the building fraternity at large, and the architectural profession in particular. The editor hopes to profit by experience.

The policy of the Chicago Architects' Business Association has been considerably modified during the past year. At the annual business meeting of the Association, held in October, the Constitution and By-laws were amended so as to admit to membership in the Association all persons legally practicing the profession of architecture in the state of Illinois. Quite a number of architects throughout the state have availed themselves of this privilege and are now members of this Association; thus enabling the Association to broaden out its work to the unifying of the profession throughout the state in a common support of all good building laws, and in an effort to have repealed all incorrect and inefficient laws. One has but to examine the records of the Illinois State Board of Examiners of architects to see that much has been accomplished by this Board in censuring or eliminating reckless and incompetent members of the profession; thus curtailing much practice prejudicial to public safety. By raising the standard of entrance to the profession, this Board has secured a much higher rank for the profession at large in the estimate of the general public. It is still hoped that our public law-makers can be made to see that public safety demands the supervision by a competent, licensed architect of all construction into which the public will be invited to enter after completion. It should be clearly understood that the only logical ground on which such law could be based, is the security of safety to the public and not on the ground of giving jobs to impecunious architects. The architect, being licensed by the great state of Illinois to practice his profession, should understand that he is charged with the responsibility of safeguarding the lives, both physically and artistically, of those who enter buildings designed by him, and should rise above mere pecuniary considerations.

It has long been felt on the part of some of the members of the Architects' Business Association that there is great need of an Information Bureau, which shall be free and unprejudiced in its reports regarding draughtsmen, and which shall relieve the draughtsmen from the heavy tax which has been levied on them by the numerous employment bureaus. This movement has finally been crystallized by the establishment of such a bureau, organized under the laws of the state, but under direct control of the Architects' Business Association. Although only equipped for effective work but a few months, this Bureau has been of great service both to architects and draughtsmen. It has not been able, however, to fill all orders, due to the impossibility of securing thoroughly competent office

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During the year very valuable illustrated addresses have been presented to the Association by Mr. Peter B. Wight, F. A. I. A., on "Clay Product Fire-proofing of Buildings;" by Theodore L. Condron, M. Am. Soc. C. E., on "Reinforced Concrete Construction;" by Mr. Fred Bauman, F. A. I. A., on "A Method for Remodeling the Lower Walls of an Existing Building without Interfering with the Wall Above, and Replacing with Columns and Beams."

The Association has discussed from time to time, at its various meetings, the question of smoke prevention, and has appointed a committee to investigate same, also on high pressure water system for fire protection, on the advisability of having real estate corporations for the purpose of constructing buildings, and the advisability of securing a competent architect as Building Commissioner for the City of Chicago. One entire meeting was given to the discussion of the benefits of the Architects' Examination and License Law. Many other subjects of more or less importance to the profession were discussed during the year.

The advantage of system in the administration of a business office needs no argumentation to prove desirability. Notwithstanding its self-evidence, however, the majority of architects' offices are, in fact, really monuments to lack of system. That this lack has done much to discredit the profession as a whole, in the eyes of the business public, cannot be gainsaid.

It is hard to convince a practical business man that a chaotic, loosely organized and conducted office can produce practical and effective architectural design or can practically and effectively safeguard the financial interests of its clients. It is, therefore, not strange that some business organizations prefer to retain engineers or contractors as chief officers in charge of their construction, making the architect a mere caudal appendage to their constructive organization, rather than the head, to which his position as designer should entitle him.

The charge is frequently made that architects are not business men, yet this profession is probably called upon to supervise the disbursement of more funds than any other single profession. That this accusation is untrue in many notable cases cannot be questioned; neither can it be questioned that it is true in many other cases. As the "sins of the fathers are visited on the children to the third and fourth generations," so the professional sins and shortcomings of individual members of a profession are visited on the entire fraternity, lowering it in the estimation of the public.

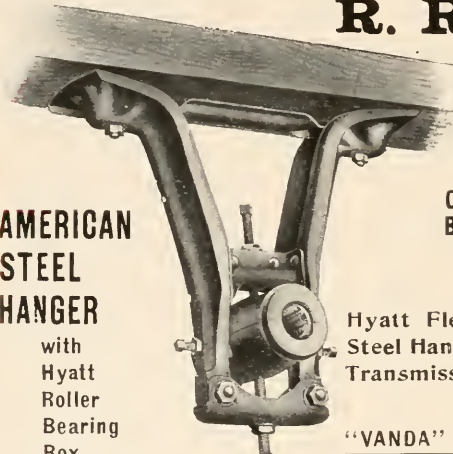
The effort of the Architects' Business Association to secure a greater uniformity of practice and a more perfect system of administration in architects' offices throughout the state, is, in consequence, justifiable. Much time has been given by its attorneys to the preparation of blank forms, so worded as to be legally effective when used by architects for the protection of their clients' interests. Considerable attention has been devoted in this number of the Handbook to the presentation of a system of classification of information and data



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required for use in architects' offices. While it may be possible for some to devise a better scheme of classification than this, at the same time it is hoped that this will be followed for the sake of uniformity, as it has already been adopted by many engineers' offices and quite generally by the public libraries throughout the country. Manufacturers and sales agents are urged to print all their literature for distribution to architects on uniform sized paper or cards, as adopted by the Association. This will greatly facilitate classification and filing of valuable pamphlets and circulars, so that they can be easily found when required for specification writing; being mutually advantageous, both to the architect and the material man. It is also desirable to print useful data regarding manufactured articles on only one side of the paper, reserving the back for testimonials, etc., so that these can be mounted, should this be desired, on specification reference cards. Two sizes are recommended: first, $10\frac{1}{2}'' \times 13''$, the average size of page of most of the architectural magazines; second, $4'' \times 6''$, the standard index rerum size, convenient for mounting post cards, small pamphlets, etc., especially convenient for pocket data. This is the size now used by quite a number of architects for inspector's report cards, bid blanks, account cards, certificate blanks and memorandum notes. The sizes adopted by the Association are particularly convenient for general use, owing to the fact that so many convenient vertical filing cabinets, of size suited to these, are now manufactured by the many builders of office furniture. These stock cabinets are constructed in both wood and steel, of finish suited to any office.

Considerable criticism has been offered by certain architects, not members of the Association, to the schedule of minimum charges for architectural service recommended by the Chicago Architects' Business Association, on the ground that these are ridiculously low for the better class of specialized service. The difficulty seems to be that these men have not considered that the schedule recommended is not maximum or even reasonably fair remuneration in special cases. The architect of particular and special training, supplemented by a broad experience in particular lines, is undoubtedly entitled to a greater remuneration for his service than the architect of limited experience and minimum technical training. The minimum charges recommended are simply based on what is considered to be a fair, living remuneration for honestly and faithfully rendered service, even by the man of minimum technical qualifications. The man of special and particular qualifications should receive greater remuneration in proportion to the increased value of his service, but this should be a matter of special contract between the architect and his client.

It frequently occurs that certain practitioners are especially qualified to render service in particular lines, while their equipment for ordinary and general practice is not above the average. In such cases, these men should receive a much higher remuneration for service along the line of their specialty than for general practice.

It is hoped that the architects throughout the state who are prevented from attending the meetings because of distance will be present by correspondence, and that in this way the isolation of the out-of-Chicago man will be largely eliminated.



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Approved June 3, 1897, and in Force July 1, 1897; with Amend-
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General Assemblies. In Force July 1, 1905.

Section 1. Appointment of a State Board of Examiners of Architects. — *Be it enacted by the People of the State of Illinois, represented in General Assembly, That* within thirty days after the passage of this act the Governor of this State shall, by the advice and consent of the Senate, appoint a State Board of Examiners of Architects, to be composed of five members, one of whom shall be a member of the faculty of the Illinois State University, and the other four shall be architects residing in the State of Illinois, who have been engaged in the practice of architecture at least ten years. Two of the said practicing architects appointed as examiners shall be designated to hold office for two years from the date of the passage of this act, and the other two, together with the member of the faculty aforesaid, shall hold office for four years from the passage of this act; and thereafter, upon the expiration of the term of office of the person so appointed, the Governor of the State shall appoint a successor to each person whose term of office shall expire, to hold office for four years, and said person so appointed shall have the above specified qualifications. In case appointment of a successor is not made before the expiration of the term of any member, such member shall hold office until his successor is appointed and duly qualified. Any vacancy occurring in membership of the board shall be filled by the Governor of the State for the unexpired term of such membership.

Sec. 2 Examiners to file Oath of Office with the Secretary of State — Treasurer to file Bond—Salary of Secretary and Members of Board of Examiners.—The members of the State Board of Examiners of Architects shall, before entering upon the discharge of their duties, make and file with the Secretary of State the constitutional oath of office. They shall, as soon as organized, and annually thereafter, in the month of January, elect from their number a president and secretary, who shall also be the treasurer. The treasurer, before entering upon his duties, shall file a bond with the Secretary of State, for such sum as shall be required of him by said Secretary of State, and in such form and with such securities as may be approved by the Governor of the State. The board shall adopt rules and regulations not inconsistent with this act to govern its proceedings, and also a seal; and the secretary shall have the care and custody thereof; and he shall keep a record of all the proceedings of the board

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which shall be open at all times to public scrutiny, and the board shall cause the prosecution of all persons violating any of the provisions of this act, and may incur necessary expenses in that behalf

The secretary of the board shall receive a salary which shall be fixed by the board, and which shall not exceed the sum of fifteen hundred (1,500) dollars per annum; he shall also receive his traveling and other expenses incurred in the performance of his official duties. The other members of the board shall receive the sum of ten (10) dollars for each day actually engaged in this service, and all legitimate and necessary expenses incurred in attending the meetings of said board. Said expenses shall be paid from the fees received by the board under the provisions of this act, and no part of the salary or other expenses of the board shall be paid out of the State treasury. All moneys received in excess of the said per diem allowance and other expenses provided for, shall be held by the treasurer as a special fund for meeting the expenses of said board, and the cost of an annual report of the proceedings of the State Board of Examiners of Architects. And any moneys that may have been heretofore paid into the State treasury to the credit of said board are hereby appropriated to the said board, to be held by it as a part of said special fund; and the Auditor of Public Accounts is hereby authorized to issue a warrant for their repayment on the requisition of said board and the approval of the Governor, in such amounts as may from time to time be required.

Sec. 3. Quorum Meetings of Board — Rules and Regulations. Three members of the board shall constitute a quorum. Special meetings of the board shall be called by the secretary upon the written request of any two members, by giving at least seven days' written notice of the meeting to each member, reckoning from the day on which the notices are postmarked, telegraphed or personally delivered. The board shall adopt rules and regulations for the examination of applicants for license to practice architecture, in accordance with the provisions of this act, and may amend, modify and repeal such rules and regulations from time to time. The board shall, immediately upon the election of each officer thereof, and upon the adoption, repeal or modification of its rules of government or its rules and regulations of examinations of applications for licenses, file with the Secretary of State, and publish in at least one architectural journal and one daily newspaper published in the State of Illinois, at least twice, the name and address of each officer, and a copy of such rules and regulations, or the amendments, repeal or modification thereof.

Sec. 4. Examinations — Applicants for License to Pay a License Fee of \$15 — License Fee, \$25. Provision shall be made by the board hereby constituted for holding examinations, at least twice in each year, of applicants for license to practice architecture, and any person over twenty-one years of age, upon payment of a fee of fifteen dollars (\$15) to the secretary of the board, shall be entitled to an examination for determining his or her qualifications. All examinations shall be made directly by said board, or a committee of two members delegated by the board, and due notice of the time and place of the holding of such examinations shall be published, as in the case provided for the publication of the rules and regulations thereof. The examination shall have special reference to the construction of buildings, and a test of the knowledge of the candidate of the strength of materials, and of his or her ability to make practical application of such knowledge in the ordinary professional work of an architect, and in the duties of a supervisor of mechanical work on buildings, and should also seek to determine his or her knowledge of the laws of sanitation as applied to buildings. If the result of the examination of any applicant shall be satisfactory to a majority of the board, under its rules, the secretary shall, upon an order of the board, issue to the applicant a certificate to that effect, and upon payment to the secretary of the board by the candidate of a fee of twenty-five dollars (\$25), he shall thereupon issue to the person therein named a license to practice architecture in the State, in accordance with the provisions of this act, which license shall contain the full name, birth-place and age of the applicant, and be signed by the president and secretary, and sealed with the seal of

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the board. If an applicant fails to pass said examination his or her fee shall be returned.

All papers received by the secretary in relation to applications for license shall be kept on file in his office, and a proper index and record thereof shall be kept by him.

Sec. 5. Architects Who are Entitled to License Without an Examination.—Any person who shall, by affidavit, show to the satisfaction of the State Board of Examiners of Architects that he or she was engaged in the practice of the profession of architecture on the date of the passage of this act, shall be entitled to a license without examination, provided such application shall be made within six months after the passage of this act. Such license, when granted, shall set forth the fact that the person to whom the same was issued was practicing architecture in this State at the time of the passage of this act, and is, therefore, entitled to a license to practice architecture without an examination by the Board of Examiners, and the secretary of the board shall, upon the payment to him of the fee of twenty-five dollars (\$25), issue to the person named in said affidavit a license to practice architecture in this State, in accordance with the provisions of this act. In the case of a copartnership of architects, each member whose name appears must be licensed to practice architecture. No stock company or corporation shall be licensed to practice architecture, but the same may employ licensed architects. Each licensed architect shall have his or her license recorded in the office of the county clerk in each and every county in this State, in which the holder thereof shall practice, and he or she shall pay to the clerk the same fee that is charged for the recording of notarial commissions. A failure to have his or her license so recorded shall be deemed sufficient cause for revocation of such license.

Sec. 6. County Clerks to Keep Record of Licenses Recorded.—Each county clerk shall keep in a book, provided for the purpose, a complete list of all licenses recorded by him under the provisions of this act, together with the date of the issuance of each license.

Sec. 7. Licensed Architects to Have a Seal.—Every licensed architect shall have a seal, the impression of which must contain the name of the architect, his or her place of business, and the words "Licensed Architect," "State of Illinois," with which he shall stamp all drawings and specifications issued from his office for use in this State.

Sec. 8. Penalty for Practicing Architecture Without a License.—After six months from the passage of this act it shall be unlawful, and it shall be a misdemeanor punishable by fine of not less than ten dollars (\$10) nor more than two hundred dollars (\$200) for each and every offense, for any person to practice architecture without a license in this State, or to advertise, or to put out any sign or card or other device which might indicate to the public that he or she is entitled to practice as an architect

Sec. 9. Persons Who Are to be Regarded as Architects.—Any person who shall be engaged in the planning or supervision of the erection, enlargement or alteration of buildings for others, and to be constructed by other persons than himself, shall be regarded as an architect within the provisions of this act, and shall be held to comply with the same; but nothing contained in this act shall prevent the draftsmen, students, clerks of works or superintendents, and other employees of those lawfully practicing as architects, under license as herein provided for, from acting under the instruction, control or supervision of their employers; or shall prevent the employment of superintendents of buildings paid by the owners from acting, if under the control and direction of a licensed architect who has prepared the drawing and specifications for the building. The term building in this act shall be understood to be a structure, consisting of foundations, walls and roof, with or without the other parts; but nothing contained in this act shall be construed to prevent any person, mechanic or builder from making plans and specifications for, or supervising the erection, enlargement or alteration of any building that is to be

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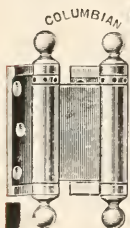
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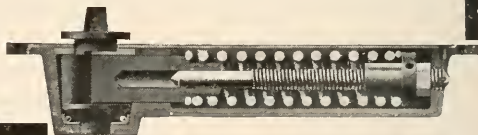
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constructed by himself or employes, nor shall a civil engineer be considered as an architect unless he plans, designs and supervises the erection of buildings, in which case he shall be subject to all the provisions of this act, and be considered as an architect.

Sec. 10. License Revoked.—Architects' licenses issued in accordance with the provisions of this act shall remain in full force until revoked for cause, as hereinafter provided. Any license so granted may be revoked by unanimous vote of the State Board of Examiners of Architects for gross incompetency, or recklessness in the construction of buildings, or for dishonest practices on the part of the holder thereof, but before any license shall be revoked such holder shall be entitled to at least twenty days' notice of the charge against him, and of the time and place of the meeting of the board for the hearing and determining of such charge. And on the cancellation of such license it shall be the duty of the secretary of the board to give notice of such cancellation to the county clerk of each county in the State in which the license has been recorded, whereupon the clerks of the counties shall mark the license recorded in his office canceled. After the expiration of six months from the revocation of a license, the person whose license was revoked may have a new license issued to him by the secretary upon certificate of the Board of Examiners, issued by them upon satisfactory evidence of proper reasons for his reinstatement, and, upon payment to the secretary of the fee of five dollars (\$5).

For the purpose of carrying out the provisions of this act relating to the revocation of licenses, the board shall have the power of a court of record, sitting in the county in which their meeting shall be held, and the power to issue subpoenas and compel the attendance and testimony of witnesses. Witnesses shall be entitled to the same fees as witnesses in a court of record, to be paid in like manner. The accused shall be entitled to the subpoena of the board for his witnesses, and to be heard in person or by counsel in open public trial.

Sec. 11. Renewal of Licenses.—Every licensed architect in this State who desires to continue the practice of his profession shall annually, during the time he shall continue in such practice, pay to the secretary of the board during the month of July a fee of five dollars (\$5), and the secretary shall thereupon issue to such licensed architect a certificate of renewal of his license for the term of one year. Any licensed architect who shall fail to have his license renewed during the month of July in each and every year shall have his license revoked; and it shall be the duty of the secretary of the board to give notice of such revocation to the county clerk in each county in the state, whereupon the clerks of the counties shall make an entry of such revocation accordingly.

But the failure to renew said license in apt time shall not deprive such architect of the right to renewal thereafter; and the secretary of the board shall give like notice of such renewal; but the fee to be paid upon the renewal of license after the month of July shall be ten (10) dollars, to cover the additional expense incurred by the board on account of such notices.

Sec. 12. Report of Proceedings to be Filed with the Auditor of Public Accounts.—Within the first week of December, after the organization of the board, and annually thereafter, the secretary of the board shall file with the Auditor of the State a full report of the proceedings of the board, and a complete statement of the receipts and expenditures of the board, attested by the affidavits of the president and secretary, subject to the approval of the State Auditor.

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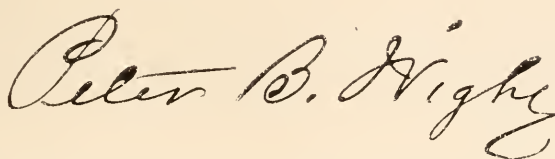
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This is to certify that I have examined the proofs of the list of Licensed Architects in the State of Illinois, made by the publishers of THE HANDBOOK FOR ARCHITECTS AND BUILDERS, and find that it agrees with the official list of Licensed Architects in this office.



Secretary of the State Board of Examiners of Architects.

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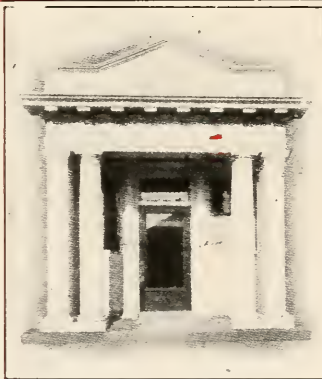
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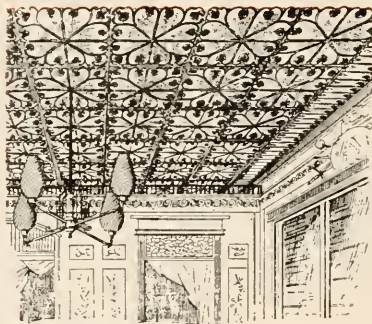
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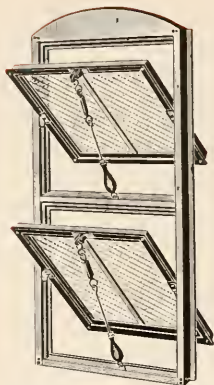
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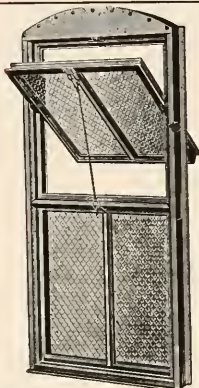
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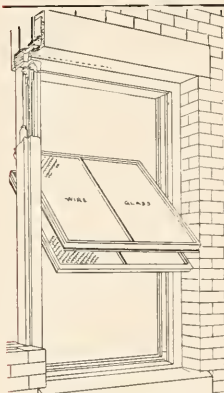
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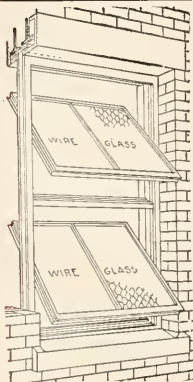
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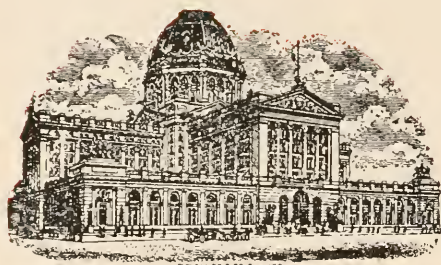
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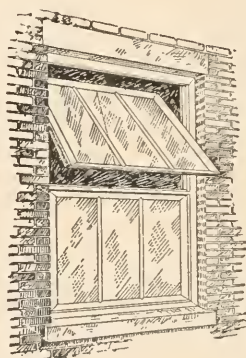
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Schedule of Minimum Charges for Professional Services
Recommended by the
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The architect's professional services consist in preparing the necessary preliminary studies, working drawings, specifications, large scale and full-size details, and in the general direction and supervision of the work, for which the minimum charge is five per cent upon the cost.

For new buildings, costing less than ten thousand dollars, and alterations and repairs, and for furniture, monuments, decorative and cabinet work, it is usual and proper to charge a special fee in excess of the above.

Consultation fees for professional advice are to be paid in proportion to the importance of the questions involved.

None of the charges above enumerated cover alterations and additions to contracts, drawings and specifications, nor professional or legal services incidental to negotiations for site, disputed party walls, right of light, measurement of work, or failure of contractors. When such services become necessary, they shall be charged for according to the time and trouble involved.

Where heating, ventilating, mechanical, electrical and sanitary problems in a building are of such a nature as to require the assistance of a specialist, the owner is to pay for such assistance. Chemical and mechanical tests, when required, are to be paid for by the owner.

Necessary traveling expenses are to be paid by the owner.

Drawings and specifications, as instruments of service, are the property of the architect.

The architect's payments are due as his work progresses in the following order: Upon completion of the preliminary sketches, one-fifth of the entire fee; upon completion of working drawings and specifications, two-fifths; the remaining two-fifths being due from time to time in proportion to the amount of work done by the architect in his office and at the building.

Until an actual estimate is received, the charges are based upon the proposed cost of the work, and payments are received as installments of the entire fee, which is based upon the actual cost to the owner of the building or other work, when completed, including all fixtures necessary to render it fit for occupation. The architect is entitled to extra compensation for furniture or other articles purchased under his direction.

If any material or work used in the construction of the building be already upon the ground or come into the owner's possession without expense to him, its value is to be added to the sum actually expended upon the building before the architect's commission is computed.

In case of the abandonment or suspension of the work, the basis of settlement is as follows: Preliminary studies, a fee in accordance with the character and magnitude of the work; preliminary studies, working drawings and specifications, three-fifths of the fee for complete services.

The supervision of an architect (as distinguished from the continuous personal superintendence which may be secured by the employment of a Clerk-of-Works) means such inspection by the architect, or his deputy, of work in studios and shops, or of a building or other work in process of erection, completion or alteration, as he finds necessary to ascertain whether it is being executed in conformity with his drawings and specifications or directions. He is to act in constructive emergencies, to order necessary changes and to define the true intent and meaning of the drawings and specifications, and he has authority to stop the progress of the work and order its removal when not in accordance with them.

On buildings where the constant services of a superintendent are required, a Clerk-of-Works shall be employed by the architect at the owner's expense.

EXCEPTIONS.

Dwelling costing less than \$10,000.....	7 per cent
Factories and warehouses	4 " "
Additions and alterations to dwellings.....	10 " "
Additions and alterations to business buildings.....	7 " "
Designs for furniture	15 " "
Monumental and wrought metal work.....	15 " "

N. B.—Above schedule is considered minimum for ordinary and usual professional service. It is not considered fair or reasonable for highly specialized service.



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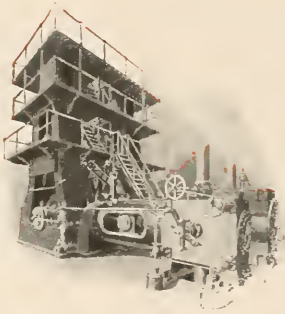
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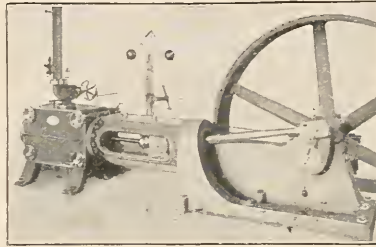
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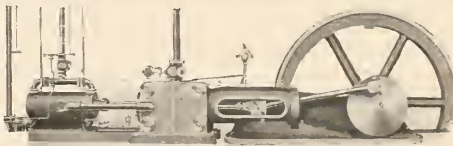


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BUILDING ORDINANCES

OF THE CITY OF CHICAGO

As contained in Chapter XV of the Revised Municipal Code of Chicago (passed March 20, 1905, published April 15, 1905), together with all amendments up to and including July 8, 1907 (adjournment of Council for summer vacation).

All amendments and additions will be found printed in italics under proper Section numbers, except the Fire Limits Ord. (Sec. 686) and Ord. covering Bill and Sign Boards and Fences (Sec. 705 to 715).

CHAPTER FIFTEEN.

ARTICLE I.

OFFICERS—POWERS AND DUTIES.

Section 199. (**Department of Buildings Established.—Officers.**)—There is hereby established an executive department of the municipal government of the city, which shall be known as the Department of Buildings, and shall embrace a Commissioner of Buildings, a Deputy Commissioner of Buildings, an Assistant Deputy Commissioner of Buildings, a Civil Engineer, a Secretary to the Commissioner, a Chief Building Inspector, and such Inspectors of Elevators, Inspectors of Stand Pipes and Fire Escapes, and Inspectors of Buildings, and such other assistants and employes as the City Council may by ordinance provide.

Sec. 200. (**Building Commissioner.—Office Created.—Appointment.—Bond.**)—There is hereby created the office of Commissioner of Buildings. He shall be the head of said Department of Buildings, and shall be an experienced architect, civil engineer, builder, or competent building mechanic, and shall have been engaged in the city as an architect, civil engineer, builder or building mechanic for a period of ten years, and during his term of office as Commissioner of Buildings, he shall not be engaged in any other business.

He shall be appointed by the Mayor, by and with the advice and consent of the City Council.

The Commissioner of Buildings before entering upon the duties of his office shall execute a bond to the city in the sum of twenty-five thousand (\$25,000) dollars, with such sureties as the City Council shall approve, conditioned for the faithful performance of the duties of his office.

Sec. 201. (**Powers.—Appointment of Subordinates.—Bonds.—Duties of Commissioner.**)—He shall have the management and control of all matters and things pertaining to the Department of Buildings, and shall appoint, according to law, all subordinate officers and assistants in his department and may remove them according to law. All subordinate officers, assistants, clerks and employes in said Department shall be subject to such rules and regulations as shall be prescribed from time to time by said Commissioner.

It shall be the duty of said Commissioner to enforce all ordinances relating to the erection, construction, alteration, repair, removal or the safety of buildings.

Sec. 202. (**Precautions in Behalf of Public Safety.—May Require Repair or Alteration in Such Cases.**)—It shall be the duty of the Commissioner of Buildings, when any citizen represents that ashes or combustible materials are kept in any place in the city in an insecure manner, or that the doors, stairways, corridors, exits or fire escapes in any factory or workshop or other place of employment are insufficient for the escape of employes in case of fire, panic or accident, or do not comply with the provisions of this chapter; or that the funnels, flues, fire boxes or heating apparatus in any building in the city are insecure or dangerous, or that any part of any building in the city is in an unsafe or dangerous condition, or in any wise in contravention of this chapter, to make an examination of such place or building, and if such representation

is found to be true, said Commissioner shall give notice in writing to the owner, occupant, lessee or person in possession, charge or control of such place or building to make such changes, alterations or repairs as public safety or the ordinances of the city may require; and it shall be unlawful to continue the use of such building until the changes, alterations or repairs found necessary by the Commissioner of Buildings to make such building or part thereof safe or to bring it into compliance with this chapter, shall have been made.

Sec. 203. (Inspection of All Buildings in General Use.—Must Report All Unsafe Conditions.—Interpretation of This Chapter.)—The Commissioner of Buildings shall inspect or cause to be inspected all public school buildings, public halls, churches, theaters and all buildings used either for manufacturing or commercial purposes, also all hotels, apartment houses and other buildings occupied by large numbers of people, for the purpose of determining the safety of such buildings, or any parts or appliances or equipment thereof; the sufficiency of their doors, passageways, aisles, stairways, corridors, exits or fire escapes and generally their facilities for egress in case of fire or other accident, and the strength of their floors, and shall make returns of all violations of the several provisions of this chapter to the Law Department for prosecution.

The Commissioner of Buildings shall have full power to pass upon any question arising under the provisions of this chapter, subject to the conditions, modifications and limitations contained therein.

Sec. 204. (Inspection of Elevators.—Power to Stop Use of Same.)—The Commissioner of Buildings shall have power to prohibit and stop the use of any passenger or freight elevator when any Inspector of Elevators shall report to him that such elevator or the hoistway in which it is used is in a dangerous or unsafe condition. Such prohibition of use shall continue in force until such hoistway or elevator, or both, shall have been put in a safe condition, and certified to be safe after a proper inspection thereof by the Inspector of Elevators.

Sec. 205. (Buildings Found in Unsafe Condition.—Notice to Owner.—Authority of Commissioner.)—If the Commissioner of Buildings shall find in the city any building or structure or part thereof in such an unsafe condition as to endanger life, but so that, by the immediate application of precautionary measures such danger may be averted, he shall have authority, and it shall be his duty to forthwith notify in writing, the owner, agent, or person in possession, charge or control of such building or structure or part thereof to adopt and put into effect such precautionary measures as may be necessary or advisable in order to place such building or structure or part thereof in a safe condition. Such notice shall state briefly the nature of the work required to be done, and said Commissioner shall specify in such notice a time within which the work required to be done shall be completed by the person notified, such time to be fixed by said Commissioner upon taking into consideration the condition of such building or structure, or part thereof, and the danger to life or property which may result from its unsafe condition.

If the owner, agent or person in possession, charge or control of such building or structure, or part thereof, when so notified, shall fail, neglect or refuse to place such building or structure, or part thereof, in a safe condition, and to adopt such precautionary measures as shall have been specified by said Commissioner within the time specified in such notice, in such case, at the expiration of such time, it shall be the duty of said Commissioner to proceed forthwith to do, or cause to be done, any and all work necessary to place such building or structure, or part thereof, in a safe condition.

If the said commissioner shall be unable to find the owner of such building, structure, or part thereof, or any agent or person in possession, charge or control thereof, upon whom such notice may be served, he shall place or cause to be placed the notice herein provided for, upon such building at or near its principal entrance, and if, at the expiration of the time specified in such notice for the completion of the work required to be done the terms of such notice shall not have been complied with, it shall be the duty of the Commissioner to thereupon proceed and do such work in the same manner as has hereinbefore been provided in cases of refusal, neglect or failure on the part of the owner, agent or person in possession, charge or control of any such building, structure or part thereof, when so notified.

If, in accordance with the provisions of this section, the work of placing any building, structure, or part thereof in a safe condition shall devolve upon the said commissioner, and it shall appear that such building, structure or part thereof is in such a condition as not to warrant the expenditure thereon of a sufficient sum of money to make such repairs or to do such work as is necessary to put it in a safe condition, the said Commissioner shall have authority to tear down or destroy such building or structure or part thereof, and the expense of tearing down and destroying any such

building or structure or part thereof, and the expense of making any repairs or doing any work thereon shall be charged to the person owning or in possession, charge or control of such building or structure or part thereof, and the Commissioner shall recover or cause to be recovered from such owner or person in possession, charge or control the cost to the city of doing such work.

Sec. 206. (Building or Part of Building Constructed in Violation of Chapter.—Authority of Commissioner to Tear Down.)—If it shall be found that any building or structure or part thereof is being or shall have been constructed or built in violation of any of the provisions of this chapter, the Commissioner of Buildings shall forthwith notify the owner, agent, superintendent or architect of, or the contractor engaged in erecting such building or structure, or part thereof, of the fact that such building or structure, or part thereof, has been, or is being, constructed or erected contrary to the provisions of this chapter, and shall specify briefly in such notice in what manner the provisions of this chapter, or any of them, have been violated, and shall require the person so notified to forthwith make such building, structure, or part thereof, conform to and comply with the provisions of this chapter, specifying in such notice the time within which such work shall be done.

If, at the expiration of the time set forth in such notice, the person so notified shall have refused, neglected or failed to comply with the request made in such notice and to have such building or structure, or part thereof, concerning which notice was sent, changed so as to conform to and comply with the provisions of this chapter, the Commissioner of Buildings shall have the authority, and it shall be his duty, to proceed forthwith to tear down or cause to be torn down such building or structure, or such part thereof as shall or may have been erected and constructed in violation of the provisions or any of the provisions of this chapter, and the cost of such work shall be charged to and recovered from the owner of such building or structure or from the person for whom such building or structure is being erected.

Sec. 207. (May Direct Fire Department to Remove.)—The Commissioner of Buildings shall also have authority to direct the Fire Department, after written notice has been served upon the owner, lessee, occupant, agent or person in possession, charge or control, personally, to tear down any defective or dangerous wall or any building or any part thereof which may be constructed in violation of the terms of this chapter. In case of the destruction, or partial destruction, of buildings by fire or by the action of the elements, when any department of the city government, pursuant to the ordinances of the city, shall make any outlay of money or incur any liability for the payment of any expense on behalf of the city in an effort to preserve or prevent the destruction of any such building or buildings, or for the preservation of the life or health of its citizens, it shall be the duty of the Commissioner of Buildings to ascertain the amount of such outlay or expenditure and present a bill therefor to the owner or owners of any such building or buildings, or his or their agent or agents, and it shall be the duty of the said Commissioner of Buildings to refuse to issue a permit for the reconstruction, alteration or repair of any such building or buildings by such owner or owners until such outlay or expenditure shall be repaid to the city by the owner or owners of such building or buildings so totally or partially destroyed in the manner aforesaid. Said Commissioner shall also proceed forthwith to collect from such owner or owners, by appropriate proceedings, the amount of such bill.

Sec. 208. (May Make Rules for Construction of Buildings and Control of Employees.)—The Commissioner of Buildings shall institute such measures and prescribe such rules and regulations for the control and guidance of his subordinate officers and employees as shall secure the careful inspection of all buildings while in process of construction, alteration, repair or removal and the strict enforcement of the several provisions of this chapter.

Sec. 209. (May Stop Construction and Wrecking of Buildings.)—Amended by ordinance Dec. 11, 1905, to read as follows:

Said Commissioner shall have power to stop the construction of any building or the making of any alterations or repairs of any building within said city when the same is being done in a reckless or careless manner or in violation of any ordinance, and to order, in writing, or by parole, any and all persons in any way or manner whatever engaged in so constructing, altering or repairing any such building, to stop and desist therefrom.

And the said Commissioner shall have power to stop the wrecking or tearing down of any building or structure within said city when the same is being done in a reckless or careless manner or in violation of any ordinance or in such a manner as to endanger life or property, and to order any and all persons engaged in said work to stop and desist therefrom. When such work has been stopped by the order of said Commissioner, it shall not be resumed until said Commissioner shall be satisfied that adequate precautions will be taken for

the protection of life and property, and that said work will be prosecuted carefully and in conformity with the ordinances of the city.

(The penalties prescribed by Section 738, for violations, shall apply with equal force and effect to violations of this section.)

Sec. 210. (Arbitration Appeal from Decision.)—In cases where discretionary power to estimate damage to frame buildings is given the Commissioner of Buildings, as also in questions relating to the security or insecurity of any building or buildings, or parts thereof, and in all other cases where discretionary powers are, by ordinance, given to the Commissioner of Buildings, an appeal to arbitration shall be allowed to parties believing themselves injured or wronged by the decisions of the Commissioner of Buildings, as follows, to wit:

Sec. 211. (Appeal.—Limit of Time of.)—Any person wishing to make such appeal shall do so within five days after written notice of the decision or order of the Commissioner of Buildings has been given him. An appeal made later than five days after the serving of the notice of the Commissioner of Buildings shall not entitle the appellant to an arbitration. The request for arbitration shall be in writing and shall state the object of the proposed arbitration and the name of the person who is to represent the appellant as arbitrator.

Sec. 212. (Appeal.—Cost of.)—The Commissioner of Buildings shall thereupon state to the appellant the cost of such arbitration, and such appellant shall, within twenty-four hours from the time of filing the original request for arbitration, deposit with the Commissioner of Buildings the sum of money required for defraying the expenses of the same, which sum shall in each case be fixed by said Commissioner in proportion to the difficulty and importance of the case, but shall in no case be more than the cost of similar service in the course of ordinary business of private individuals or corporations. As soon as such sum of money shall have been deposited with him the Commissioner of Buildings shall appoint an arbitrator to represent the city, and the two arbitrators thus appointed shall, if they cannot agree, select a third arbitrator, and the decision of any two of these arbitrators shall, after investigation of the matter in question, be final and binding on the appellant as well as upon the city.

Sec. 213. (Arbitrators to Take Oath.—Power to Examine Witnesses.)—The arbitrators shall themselves, before entering upon the discharge of their duties, be placed under oath to the effect that they are unprejudiced as to the matter in question and that they will faithfully discharge the duties of their position. They shall have the power to call witnesses and place them under oath, and their decision or award shall be rendered in writing both to the Commissioner of Buildings and to the appellant from his decision. The fee deposited by the appellant with the Commissioner of Buildings shall be paid by the Commissioner of Buildings to the arbitrators upon the rendering of their report, and shall be in full of all costs incident to the arbitration; but should the decision of said board of arbitration be rendered against the Commissioner of Buildings, then the money deposited by the aforesaid appellant shall be returned to him, and the entire cost of such arbitration shall be paid by the city.

Sec. 214. (In Urgent Cases.—Commissioner's Power Final.)—Whenever the decision of the Commissioner of Buildings upon the safety of any building or any part thereof is made in a case so urgent that failure to properly carry out his orders to demolish or strengthen such building or part thereof may endanger life and limb, the decision and order of the Commissioner of Buildings shall be absolute and final.

Sec. 215. (Duty of Police to Assist Commissioner in Enforcing Provisions of This Chapter.)—Whenever it shall be necessary, in the opinion of the Commissioner of Buildings, to call upon the Department of Police for aid or assistance in carrying out or enforcing any of the provisions of this chapter, he shall have the authority so to do, and it shall be the duty of the Department of Police, or of any member of said Department, when called upon by said Commissioner, to act according to the instructions of, and to perform such duties as may be required by, said Commissioner in order to enforce or put into effect the provisions of this chapter.

Sec. 216. (Certificates.—Notices.—Register.)—The Commissioner of Buildings shall sign or cause to be signed all certificates and notices required to be issued from said Department, and keep a record of the same, and issue or cause to be issued all permits authorized herein. He shall also keep in proper books for that purpose a register of all transactions of the Department of Buildings, which such books shall be open to the inspection of the Mayor, Comptroller, Superintendent of Police, Fire Marshal and members of the City Council at all times.

Sec. 217. (Must Keep Account of Fees Paid.—Annual Reports and Estimates.)—Said Commissioner shall keep, in proper books for that purpose, an accurate account of all fees paid, giving the name of the person paying same, date of payment and amount of each such fee. He shall also annually, on or before the first day of February, in each year, prepare and present to the City Council a report showing the receipts and expenditures and entire work of his Department during the previous fiscal year, and he shall at the same time send to the Comptroller a full and comprehensive statement of all matters pertaining to his Department, together with an estimate in detail of the appropriations required by the Department during the current fiscal year.

Sec. 218. (Deputy Commissioner of Buildings.)—There is hereby created the office of Deputy Commissioner of Buildings. He shall be appointed by the Commissioner of Buildings according to law. Whenever the Commissioner of Buildings shall make requisition upon the Civil Service Commission of the city for a person to fill the office of Deputy Commissioner of Buildings, he shall notify the Civil Service Commission that the person certified to fill said office should be a competent civil engineer, architect or builder.

Sec. 219. (Duties.—Bond.)—Said Deputy Commissioner shall pass upon all questions relating to the strength and durability of buildings; shall examine and approve all plans before a building permit is issued for the construction of any building or structure; shall supervise and have charge of all books and records and the various Inspectors employed in the Department of Buildings; shall receive, examine and file all reports made by them, and shall, under the direction and supervision of the Commissioner of Buildings, assign to such Inspectors the work they are to perform. He shall have a book or books in which shall be recorded the location and character of every building for which a permit is issued, and a copy of every report of inspection made for such building, so arranged that the full history of the various inspections of the building shall appear therein in consecutive order, with the name of each Inspector making the inspection thereof and the date of his report. He shall cause to be kept a record of all complaints of violations of the building ordinances, shall report the same to the Commissioner of Buildings, and shall cause all such complaints to be investigated. He shall act as Commissioner of Buildings in the absence of the Commissioner of Buildings from his office, and while so acting shall discharge all the duties and possess all the powers invested in or imposed upon the Commissioner of Buildings.

He shall before entering upon the duties of his office execute a bond to the city in the sum of ten thousand (\$10,000) dollars, with such sureties as the City Council shall approve, conditioned for the faithful performance of the duties of his office.

Sec. 220. (Assistant Deputy Commissioner of Buildings.—Bond.)—There is hereby created the office of Assistant Deputy Commissioner of Buildings. He shall be appointed by the Commissioner of Buildings according to law. Whenever the Commissioner of Buildings shall make requisition upon the Civil Service Commission of the city for a person to fill the office of Assistant Deputy Commissioner of Buildings, he shall notify the Civil Service Commission that the person certified to fill said office should be a competent civil engineer, architect or builder.

The Assistant Deputy Commissioner of Buildings shall, under the direction of the Commissioner of Buildings or the Deputy Commissioner of Buildings, assist and aid the Deputy Commissioner in the performance of his duties.

The Assistant Deputy Commissioner of Buildings, before entering upon the duties of his office, shall execute a bond to the city in the sum of five thousand (\$5,000) dollars, with such sureties as the City Council shall approve, conditioned for the faithful performance of the duties of his office.

Sec. 221. (Secretary.—Duties.)—The Commissioner of Buildings shall appoint a Secretary, according to law, whose duty it shall be to preserve and keep, under the supervision and direction of the Deputy Commissioner of Buildings, all books, records and papers belonging to said office or which are required by law to be filed therein. The Secretary shall deliver to the City Council and to the respective departments all communications from said Commissioner, in writing, and perform such services as may be required by said Commissioner or Deputy Commissioner of Buildings.

Sec. 222. (Chief Building Inspector.—Bond.)—There is hereby created the office of Chief Building Inspector. He shall be appointed by the Commissioner of Buildings according to law. Whenever the Commissioner of Buildings shall make requisition upon the Civil Service Commission of the city for a person to fill the office of Chief Building Inspector he shall notify the Civil Service Commission that the person certified to fill said office should be a competent civil engineer, architect or builder.

The Chief Building Inspector shall, under the direction of the Commissioner of Buildings, inspect and examine special cases of violations of the provisions of this chap-

ter, damages to buildings by fire, the elements or accident of any kind whatsoever, and shall perform such other duties as may be required by the Commissioner of Buildings or the Deputy Commissioner of Buildings. The Chief Building Inspector, before entering upon the duties of his office, shall execute a bond to the city in the sum of five thousand (\$5,000) dollars, with such sureties as the City Council shall approve, conditioned for the faithful performance of the duties of his office.

Sec. 223. (**Inspectors.—Not to Engage in Business.**)—The Inspectors of Buildings, after their appointment to office, shall not be engaged in any other business or vocation.

Sec. 224. (**Inspectors.—Duties.—Reports.—How Made.**)—The said Inspectors shall, under the direction of the Commissioner of Buildings, examine all buildings in the course of erection, alteration, repair or removal throughout the city at least once a week, or as often as may be required for securing efficient supervision, and shall make written reports to said Commissioner as to all violations of any ordinance of the city which the Department of Buildings is required to enforce, together with the street and number where such violations are found, the names of the owner, agent, lessee, or occupant thereof, and of the architect, contractor and master mechanic, engaged in or about the construction of such building and all other matters relative thereto as far as they can ascertain them.

Inspectors of Buildings shall file daily reports of their work of inspection, which shall be entered in the books to be kept for that purpose, and which shall be open to official inspection at all times.

Sec. 225. (**Inspection.—Record of.—How Made.**)—The said Inspectors shall examine all buildings and walls reported dangerous or damaged by fire or accident and make a record of such examinations, with the name of the street and number of the building and of the names of the owner, agent, lessee and occupant thereof.

Sec. 226. (**Alteration, Enlargement or Raising.—Inspection of.—Other Duties.**)—The Inspectors of Buildings shall examine all buildings for which an application to raise, enlarge or alter has been made, and shall make a written report upon the condition of the same to the Commissioner of Buildings before the permit is granted. Said Inspectors shall perform such other duties as may be required of them by said Commissioner of Buildings, the rules and regulations of the Department of Buildings, or the ordinances of the city.

Sec. 227. (**Powers.—Other.**)—The Commissioner and Deputy Commissioner of Buildings, as well as the Inspectors of Buildings and of Elevators, are empowered to enter any building, whether completed or in process of erection, for the purpose of determining whether the same has been or is being constructed in accordance with the terms of this chapter, and it shall not be lawful to exclude them from such buildings.

Sec. 228. (**Elevator Inspectors.—Not to Engage in Business.—Duties.**)—The Inspectors of Elevators shall not, after their appointment to office, be employed or engaged in any other business or vocation.

The Inspectors of Elevators shall perform such duties as may be required of them by the Commissioner of Buildings, the rules and regulations of the Department of buildings or the ordinances of the city.

ARTICLE II.

PERMITS, PLANS AND FEES.

Sec. 229. (**Permits.—When Required.—Limitations of Time For.**)—Amended by ordinance Feb. 26, 1906, to read as follows:

Before proceeding with the erection, enlargement, alteration, repair or removal of any building in the city, a permit for such erection, enlargement, alteration, repair or removal shall first be obtained by the owner or his agent from the Commissioner of Buildings, and it shall be unlawful to proceed with the erection, enlargement, alteration, repair, or removal of any building or of any structural part thereof within the city unless such permit shall first have been obtained from the Commissioner of Buildings. And, if after such permit shall have been granted, the operations called for by the said permit shall not be begun within six months after the date thereof, or if such operations are not completed within a reasonable time, then such permit shall be void, and no operations thereunder shall be begun or completed until a new permit shall be taken out by the owner or his agent, and fees as herein fixed for the original permit shall be paid for such new permit.

Sec. 230. (Approval of Architects' Plans.)—Amended by ordinance Feb. 26, 1906, to read as follows:

In all cases where a licensed architect shall have completed, signed and affixed his seal to plans, drawings or specifications for any building designed to be erected within the corporate limits of the city, or any structural part thereof, for which a building permit must be procured before the same may be erected, the architect making such plans, drawings, or specifications, shall submit same to the Commissioner of Buildings for examination and approval; and, if the same shall comply with the provisions of this chapter the said Commissioner shall stamp such plans, drawings or specifications in such a manner as to indicate that same have been examined and approved, and the date of such approval, and such stamp shall be preliminary to the final stamp hereinafter provided for.

Said preliminary stamp shall be so affixed before any contract or contracts shall be entered into on behalf of said owner in regard to the construction of said building or buildings on the part of said architect or other person or persons.

Sec. 231. (Permits.—Application For.—How Made.—How Recorded.—Stamped Plans.—How Cared For.—Return of Same.)—Amended by ordinance Feb. 26, 1906, to read as follows:

Application for such permits shall be made by the owner or his agent to the Commissioner of Buildings. When such application is made, plans and specifications in conformity with the provisions of this chapter, which have been examined and approved by said Commissioner as hereinbefore provided for, shall be filed with the Commissioner of Buildings, who shall then issue a permit and shall file such application, and shall apply to such plans and specifications a final official stamp, stating that the drawings and specifications to which the same have been applied comply with the terms of this chapter. The plans and specifications so stamped shall then be returned to such applicant. True copies of so much of such plans and specifications as may be required in the opinion of the Commissioner of Buildings to illustrate the features of construction and equipment of the building referred to, shall be filed with the Commissioner of Buildings and shall remain on file in his office until the completion or occupation of such building, after which such drawings and specifications shall be returned by the Commissioner of Buildings to the person by whom they have been deposited with him upon demand. It shall not be obligatory upon the Commissioner of Buildings to retain such drawings in his custody for more than three months after the completion or occupation of the building to which they relate.

Sec. 232. (Plans.—Essentials Of.)—All such plans and drawings shall be drawn to a scale of not less than one-eighth of an inch to the foot, on paper or cloth, in ink, or by some process that will not fade or obliterate. All distances and dimensions shall be accurately figured, and drawings made explicit and complete, showing the entire sewerage and drain pipes and location of all plumbing fixtures within such building. Each set of plans presented shall be accompanied by a set of specifications describing all materials to be used in the proposed building, and both the plans and specifications shall be approved by the Commissioner of Buildings before a permit will be granted. No permit shall be granted or plans approved unless such plans shall be signed and sealed by a licensed architect, as provided in "An act to provide for the licensing of architects and regulating the practice of architecture as a profession in the State of Illinois," approved June 3, 1897, provided, that permits may be granted for the erection of buildings of Class III., as hereinafter defined, if such building shall not be more than two stories in height and shall have a superficial area of not more than 1,250 square feet outside dimensions, on plans approved by the Commissioner of Buildings, which plans need not be signed by a licensed architect.

Sec. 233. (Plans.—Alterations Upon Stamped Plans Not Permitted Without Permission.—Certain Alterations Excepted.)—It shall be unlawful to erase, alter or modify any lines, figures or coloring contained upon such drawings or specifications so stamped by the Commissioner of Buildings or filed with him for reference. If, during the progress of the execution of such work, it is desired to deviate in any manner affecting the construction or other essentials of the building from the terms of the application, drawing or specification, notice of such intention to alter or deviate shall be given to the Commissioner of Buildings, and his written assent shall first be obtained before such alteration or deviation may be made. Alterations in buildings which do not involve any change in their structural parts or of their stairways, elevators, fire escapes or other means of communication or ingress or egress and that are not in violation of any of the provisions of this chapter may be made without the permission of the Commissioner of Buildings.

Sec. 234. (Deposit With Water Department.—How Made.—Indemnifying Bond.—Fees for Water Used.)—Before the Commissioner of Buildings issues a permit as aforesaid he shall require evidence from the applicant that payment has been made to the Bureau of Water of the city for the water to be used or for a water meter for measuring

all the water to be used in the construction of such building, under the regulations of the Bureau of Water. Such applicant shall produce evidence that he has filed with and had approved by the Commissioner of Public Works of the City an indemnifying bond protecting the city against any and all damage that may arise to the streets or alleys upon which such building abuts, and to the city and to any person in consequence or by reason of the proposed operations to be authorized by such permit, or by reason of any obstruction or occupation of any street or sidewalk in and about such building operations.

The fees to be paid for water used in connection with the erection of buildings shall be as follows, to wit:

For water to be used in connection therewith at the rate of five cents for every one thousand bricks, wall measure, used in the construction of a building.

At the rate of six cents for every one hundred cubic feet of rubble stone used in connection therewith.

At the rate of eight cents for every one hundred cubic feet of concrete used in connection therewith.

At the rate of fifteen cents for every one hundred yards of plastering used in connection therewith.

At the rate of five cents for every one hundred cubic feet of hollow tile arch, partition or fireproof covering used in any building.

Sec. 235. (Permits.—Cost of.)—The fees to be charged for building permits shall be as follows: For sheds not exceeding three hundred square feet in area, two dollars; for open shelter sheds, at the rate of fifty cents for each one thousand cubic feet or part thereof; but in no case shall a permit be issued for a less fee than two dollars.

For all buildings other than sheds and open shelter sheds, as hereinbefore described, the fee for the permit shall be at the rate of ten cents for every one thousand cubic feet or fractional part thereof contained therein, the cubic contents being measured to include every part of the building from the basement floor to the highest point of the roof and to include all bay-windows and other projections; but in no case shall any permit be issued for a less fee than two dollars, *except that for a permit for shingling a roof of any building the fee shall not exceed one dollar.*

As amended by ordinance of June 5, 1906.

Sec. 236. (Permit for Alterations and Repairs.—Cost Of.)—The fee to be charged for permits issued for alterations and repairs in or to any building or structure shall be as follows:

Where such alteration or repair shall equal fifty per cent. or more of the original building or structure to be altered or repaired, or of such part or portion of such building or structure to be altered or repaired, the same fees shall be charged as if such permit were for the construction of a new building.

Where such work of alteration or repair shall be less than fifty per cent. of the original building or structure or of the part or portion to be altered or repaired, the fee to be charged for a permit for such work shall be half that charged for the issuance of a permit for new work.

Sec. 237. The fee for a permit to raise a frame building shall be one dollar.

Sec. 238. (Permits for Raising or Moving Buildings Other Than Frame.)—The fee for a permit to raise or move a building other than a frame building shall be two (\$2) dollars for every twenty-five (25) feet, or fractional part thereof, of frontage, and when such building is to be moved from one location to another it shall be altered or reconstructed so as to conform to the ordinances governing the construction of such building at the time of moving the same.

Sec. 238a. (Permit for Wrecking Building.)—Added by ordinance Dec. 11, 1905:

Before proceeding with the wrecking or tearing down of any building or structure a permit for such wrecking or tearing down shall first be obtained by the owner or his agent from the Commissioner of Buildings, and it shall be unlawful to proceed with the wrecking or tearing down of any building or structure or any structural part thereof within the city unless such permit shall first have been obtained. Application for such permit shall be made by such owner or his agent to the Commissioner of Buildings, who shall issue such permit upon such application and the payment of the fee herein provided for. Such application shall state the location and describe the building which it is proposed to wreck or tear down. The fee for such permit shall be two dollars for every twenty-five feet or fractional part thereof, of frontage. Upon the issuance of such permit such building may be wrecked or torn down, provided that all the work done thereunder shall be subject to the supervision of the Commissioner of Buildings, and shall be performed under the same restrictions as govern the erection of buildings.

(The penalties prescribed by Section 738, for violations, shall apply with equal force and effect to violations of this section.)

Sec. 239. (**Permit.—Revocation Of.**)—If work in, upon or about any building shall be conducted in violation of any of the provisions of this chapter, it shall be the duty of the Commissioner of Buildings to revoke the permit for the building operation in connection with which such violation shall have taken place. It shall be unlawful, after the revocation of such permit, to proceed with such building operations unless such permit shall first have been reinstated or reissued by the Commissioner of Buildings. Before a permit so revoked may be lawfully reissued or reinstated the entire building and building site shall first be put into condition corresponding with the requirements of this chapter, and any work or material applied to the same in violation of any of the provisions of this chapter shall be first removed from such building.

ARTICLE III.

CLASSIFICATION OF BUILDINGS.

Sec. 240. (**Buildings.—Classes Of.**)—All buildings (other than sheds and shelter sheds, as hereinafter described) now existing or hereafter constructed, altered or enlarged within the city, shall be classified as follows:

Sec. 241. (**Class I.**)—In Class I. shall be included every building used for the sale, storage or manufacture of merchandise, other than department stores, as described in Section 247 of this chapter, and all stables covering or occupying a ground area of over five hundred square feet.

Sec. 242. (**Class II.**)—In Class II. shall be included every office building, hospital and every building used for hotel purposes or for boarding or lodging house purposes where such building so used for hotel or boarding or lodging house purposes is occupied by twenty or more persons.

Sec. 243. (**Class III.**)—In Class III. shall be included every building used as a family residence, also every building used for stabling purposes where such building so used shall occupy a ground area of less than five hundred square feet.

Sec. 244. (**Class IV.**)—In Class IV. shall be included every building used as an assembly hall, whether such hall is used for the purpose of worship, instruction or entertainment, unless such building is used for any of the purposes for which buildings of Class V. or Class VIII. are used.

Sec. 245. (**Class V.**)—In Class V. shall be included every building which is used as a public theater where an admission fee is charged and in which movable scenery is used; provided, however, that public halls and club halls with a seating capacity of less than six hundred, although occasionally used for theatrical representations, shall not be construed to be public theaters within the meaning of the term as used in this section, notwithstanding the fact that movable scenery is used upon the stage thereof on such occasions, and such public halls and club halls shall not be considered as buildings of Class V. as herein defined. Such public halls and club halls shall be included in Class IV., as defined in Section 244 of this chapter.

Sec. 246. (**Class VI.**)—In Class VI. shall be included every tenement and apartment house; that is to say, any house or building or portion thereof which is used as a home or residence for two or more families living in separate apartments.

Sec. 247. (**Class VII.**)—In Class VII. shall be included all buildings used for the sale at retail of dry goods and other articles of general merchandise and commonly known and described as "department stores."

Sec. 248. (**Class VIII.**)—In Class VIII. shall be included every building used exclusively for school purposes.

Sec. 249. (**Buildings Used for the Purposes of More Than One Class.**)—Where any building is used for the purposes of two or more classes as herein specified and defined, such portion of any such building as is devoted to the uses and purposes of any particular class shall be constructed, operated and maintained in accordance with the requirements of this chapter relating to such class, unless such construction shall prove impracticable or unless there would be a conflict between the provisions of this chapter relating to the construction of buildings; in either of which such cases the provisions relating to and governing the construction of buildings of the class requiring the best and safest form of construction shall govern.

Sec. 250. (**Conflict Between Special and General Provisions.**)—Whenever any provision or requirement of this chapter relating specifically to the construction, equipment, maintenance or operation of any building or part of a building used for the

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purposes of any specified class shall conflict with the general provisions of this chapter relating to the construction, operation and equipment of buildings generally, the special provisions shall govern in each case, except in the case of Section 634, which shall govern in all cases coming within its provisions.

ARTICLE IV.

PROVISIONS RELATING SOLELY TO CLASS I.

In Class I. shall be included every building used for the sale, storage or manufacture of merchandise other than department stores, as described in Sections 60 and 700, and all stables covering or occupying a ground area of over five hundred square feet.

Sec. 251. (Walls of Class I.—Thickness Of.)—The thickness of surrounding walls and of all dividing walls in every building used wholly or in part for the purposes of Class I. shall be made as indicated in the following table, to wit:

	Basement.	STORIES											
		1	2	3	4	5	6	7	8	9	10	11	12
One-story	12	12											
Two-story	16	12	12										
Three-story	16	16	12	12									
Four-story	20	20	16	16	12								
Five-story	24	20	20	16	16	16							
Six-story	24	20	20	20	16	16	16						
Seven-story	24	20	20	20	20	16	16	16					
Eight-story	24	24	24	20	20	16	16	16	16				
Nine-story	28	24	24	24	20	20	20	16	16	16			
Ten-story	28	28	28	24	24	24	20	20	20	16	16		
Eleven-story	28	28	28	24	24	24	20	20	20	16	16	16	
Twelve-story	32	28	28	28	24	24	20	20	20	16	16	16	16

Provided, however, in buildings of steel skeleton fireproof construction thickness of walls shall be governed by Section 510 of this chapter.

Sec. 252. (Buildings.—Height and Construction Of.)—Buildings of Class I. which are one hundred feet or more in height shall be built entirely of fireproof construction.

Buildings of Class I. less than one hundred feet and more than sixty feet in height shall be built entirely of slow-burning, mill or fireproof construction.

No building of Class I. more than five stories in height shall be permitted to be built of ordinary construction.

Sec. 253. (Walls.—Exception to Table of Thickness Of.)—If buildings of Class I. are erected of less depth than 100 feet from front to rear or between cross walls, or if the walls supporting their floors and roofs are less than twenty-five feet apart, the thickness of the walls given in the aforesaid table may be reduced by four inches, excepting only that no wall in such buildings shall be less than twelve inches thick.

Sec. 254. (Walls.—Metal Lath, and Solid Cement Plaster Covering.)—A one or two-story building used for the purposes of Class I., no part of which is within twenty feet of any lot line, alley line or street line, having a complete self-supporting steel frame consisting of wall columns supporting steel trusses, with steel trusses and steel diagonals designed to resist safely within the safe limits of stress provided by this chapter a wind pressure of thirty pounds per square foot for each and every exterior surface exposed to the wind, in addition to the dead weight of the completed structure and in addition to the live load of one hundred pounds per square foot provided for by this chapter and any other live loads which may be imposed on said structure, may have exterior walls measuring not less than one and one-third inches thick of metal, lath or metal fabric plastered on both sides with a mortar consisting only of Portland cement and torpedo sand. A complete reinforced concrete framework built in every manner equally as strong and as safe as provided for a steel frame in this section may have exterior walls built in the same manner of the same materials and of the same thickness.

Sec. 255. (Door Openings at Street Level.—Class I.)—The aggregate width of door openings at the street level in buildings of Class I. shall be equal to the aggregate width of stairways, as specified in Section 265 of this chapter, and such doors shall not be locked during business hours or while such buildings are occupied by a number of persons for any purpose. Revolving doors shall not be considered as complying with this section, unless the revolving wings of said revolving doors are so arranged that by the application of a force slightly more than necessary to revolve said doors and which one person of ordinary strength is capable of exerting, all the wings of said doors fold flat on



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each other and in an outward direction, and unless each side, or the half circles of such revolving doors, are hinged and fastened so as to likewise swing backwards on application of force slightly beyond the normal, and which will permit of exit space for two ordinary persons on either side of the collapsed wings of said revolving doors and their inclosing half circles.

As amended by ordinance March 30, 1906.

Sec. 256. (Buildings of Class I.—Increasing Height Of.)—In all cases where buildings of Class I., of ordinary construction, already built, are to be increased in height above the height of sixty feet or above the height of one hundred feet, the additional parts of such buildings shall be constructed as herein provided for buildings over sixty feet high or over one hundred feet high, respectively, and shall be made to conform in all respects and throughout their entire extent to the requirements for buildings of this class more than sixty feet or more than one hundred feet high, respectively, before it shall be lawful to occupy them.

Sec. 257. (Ceilings and Roof of Class I.—Space Between.)—In buildings of Class I., if the inclosed space between the ceiling and the roof is of greater average height than two feet, easy and convenient means of access, satisfactory to the fire marshal, shall be given to such space.

Sec. 258. (Fire Walls.—In Buildings of Class I.)—Buildings occupied by more than one person or corporation, or for more than one business enterprise conducted by the same person or corporation, in separate inclosures on any one floor, shall have a brick dividing wall for every fifty (50) feet of street frontage if of ordinary construction, or for every eighty (80) feet of street frontage if of slow-burning or mill construction, and such dividing walls shall extend from the front to the rear wall, and such dividing walls, and the doors therein shall be built as dividing walls, and the doors therein are required to be built by the provisions of this chapter.

All of the partitions between the parts of such buildings, occupied by different persons or corporations shall be built of incombustible material from the floor to the floor boards or roof boards next above such story or stories so occupied.

Only metal framed windows glazed with one-quarter inch thick fire-resisting glass may be used in such partitions.

Sec. 259. (Dividing Walls.—When Required in Class I.)—Dividing walls will be required in buildings of Class I. as follows: For buildings of ordinary construction if their floor area exceeds nine thousand square feet; for buildings of slow-burning or mill construction more than one story in height if their area exceeds twelve thousand square feet; for fireproof buildings more than two stories in height, if their area exceeds twenty-five thousand square feet. In each of the before mentioned cases such buildings shall be subdivided by brick walls built of the thickness given in the table for the thickness of inclosing walls, and all doors and other openings in such walls shall have iron doors or shutters at each side of same. The buildings so subdivided shall be treated as regards stairs and fire escapes the same as two or more separate buildings, provided, however, one-story buildings of ordinary, mill or slow-burning construction or two-story buildings of fireproof construction of any size, used as one store, room or workshop and occupied by only one person or corporation, may be erected without any dividing walls.

Sec. 260. (Dividing Walls and Iron Doors.—Openings Inserted In.)—If openings are to be inserted in dividing walls, as before described, or in dividing walls between non-fireproof and fireproof buildings or parts of either of such buildings, they shall be made as follows:

They shall have doors placed on each side of each opening in such walls, which doors shall be made of No. 12 plate iron with a continuous 2 by 2 by one-half-inch angle iron frame extending all around the same and the plate riveted thereto with one-half-inch rivets, placed four inches between centers. If such doors are made double they shall have cross bars, levers and hooks so arranged that when the doors are closed they will be of strength equal to that of a single door. All doors shall be hung on frames made of three-quarter by 4-inch iron stiffened with an angle iron extending all around the same and fitting up snug to the wall. The frames shall be fastened to each other by bolts extending through the wall, such bolts being not more than two feet apart, and such doors shall swing on three hinges and shall be made to fit closely to the frame all around. The sills between the doors shall be of brick, iron, stone or concrete and shall rise at least two inches above the floor on each side of each opening. The lintel over the door shall be made of brick or iron, and the wall between the two door frames shall be covered with a coat of plaster at least one-half inch thick.

Sec. 261. (Elevator Buildings.—Bins Of.)—Elevator buildings (which term shall be interpreted as including all buildings intended solely for the receipt, storage and

delivery of grain in bulk) may be constructed with the bin walls, both externally and internally, made entirely of wood; provided such walls are made solid and without cellular open spaces within them. The external bin walls shall have a covering of brick or hollow tile not less than twelve inches thick, which shall be united to the bin walls by anchors, in the construction and arrangement of which due allowance is made for the variations of shrinkage of the inclosing wall and of the wooden bin wall. If the weight of the bins is independently carried on a skeleton construction of timber, steel or iron, the first-story walls shall be of brick not less than twenty inches thick. If the outer walls of the outside bins and their facing are not carried on a skeleton construction, then the first-story wall shall not be less than twenty-eight inches thick, or as much thicker as may be required to keep the load upon the brickwork within the limits of stress elsewhere specified in this chapter. Elevator buildings may be built of reinforced concrete and in such case they shall be built according to the provisions of Section 554 of this chapter.

Sec. 262. (Cupola.—Inclosing Walls Of.—Openings.)—The inclosing walls of cupolas on elevator buildings, if constructed of wood, shall be covered with corrugated iron or other incombustible material.

The outside openings in elevator buildings shall have protections of wire netting made of No. 14 wire, with meshes not over one-half by one-half inch.

All openings in the body of the first story of elevator buildings and the openings in the engine and boiler houses of the same and between these and the main building shall have iron doors made in accordance with the provisions of Section 260 of this chapter.

Sec. 263. (Ventilating Ducts.—Chutes.—Walls Surrounding.)—Walls surrounding ventilating ducts and rubbish and ash chutes shall be constructed in accordance with the regulations governing the construction of smoke flues elsewhere herein contained. Walls around ventilating ducts shall not be less than four inches thick, and when the ventilating duct is larger than 260 square inches the walls shall be not less than eight inches thick.

Sec. 264. (Store Fronts.—Columns and Lintels Supporting.)—The columns and lintels supporting store fronts in buildings within the fire limits of more than one story in height shall be made of incombustible material.

Sec. 265. (Stairs in Buildings of Class I.—Number and Width Of.)—There shall be in all buildings of Class I. of ordinary construction and of less floor area than one thousand square feet and not more than two stories in height, a stairway not less than three feet in width, and in all buildings of ordinary construction of more than one thousand square feet of floor area and less than three thousand square feet of floor area, two flights of stairs not less than three feet wide each. For buildings of ordinary construction of Class I. and of greater floor area than three thousand square feet, there shall be six inches added to the width of each such flight of stairs for each additional one thousand square feet of floor area, or fractional part thereof, up to nine thousand square feet of floor area.

For buildings of slow-burning or mill construction with a floor area of less than twelve hundred square feet and not more than two stories in height, there shall be a stairway not less than three feet in width; buildings of a greater floor area than twelve hundred square feet and less than four thousand square feet shall have two flights of stairs, not less than three feet wide each, and there shall be six inches added to the width of each such flight of stairs for each additional one thousand square feet of floor area, or fractional part thereof, up to twelve thousand square feet. Provided, however, that additional flights of stairs may be used to make the aggregate width required, instead of widening the two flights above mentioned. It is further provided, however, that such stairs may be reduced one foot in width for each four stories in height, or fractional part thereof, above the fourth story of such building, but such stairs shall in no case be of less width than three feet.

For fireproof buildings there shall be required one flight of stairs not less than four feet wide for the first 3,000 square feet of floor area, or fractional part thereof. For buildings of more than 3,000 square feet and not exceeding 5,000 square feet of floor area, there shall be required one flight of stairs not less than five feet in width. For more than 5,000 square feet and less than 10,000 square feet of floor area there shall be an additional flight of stairs not less than three feet in width. For more than 10,000 square feet and less than 15,000 square feet of floor area, each of such stairs shall be of not less width than five feet. For more than 15,000 square feet and less than 25,000 square feet of floor area, there shall be not less than three stairways of an aggregate width of fifteen feet; none of such stairs shall be of less width than three feet.

The width of the different stairways need not be alike. The width of each stairway in the fifth, sixth, seventh and eighth stories may be six (6) inches less in the clear than the width of the stairways in the first to the fourth stories, inclusive.

The width of each stairway in the ninth, tenth, eleventh and twelfth stories may be twelve (12) inches less in the clear than the width of the stairways in the first to the fourth stories, inclusive.

The width of each stairway in the thirteenth, fourteenth, fifteenth and sixteenth stories may be eighteen (18) inches less in the clear than the width of the stairways in the first to the fourth stories, inclusive, and this reduction in width may be continued in the same ratio in each additional four (4) stories added to the height of the building; provided, however, that no stairway shall have a less clear width than three (3) feet.

All stairways in buildings of Class I, shall have a hand rail on each side thereof, and where there is more than one stairway in any building of Class I, such stairways shall be located at each end of the building, or as far apart from each other as is practicable.

Doors and Windows.—When required to be closed, fire-resisting glass. See Section 632.

Limitations in Changing Class of Buildings.—See Section 633.

Buildings Used for the Purposes of More Than One Class.—See Section 249.

Sec. 266. (**Courts, Light Shafts and Well Holes.**)—Courts, light shafts and well holes shall be built in accordance with the provisions of Section 455 of this chapter.

Sec. 267. (**Loads.—Allowance for Live Loads in Construction of Floors of Class I.**)—The floors of all buildings of Class I shall be designed and constructed in such a manner as to be capable of bearing in all their parts, in addition to the weight of floor construction, of partitions and permanent fixtures and mechanisms that may be set upon the same, a live load of one hundred pounds for every square foot of surface in such floor; and the strength of such building shall be increased above the capacity to carry such a live load of one hundred pounds per square foot of floor surface when the uses to which such building or part thereof is to be applied involve greater stress.

Sec. 268. (**Floors.—Display of Placard Indicating Strength Of.**)—It shall be the duty of the owner of every building of Class I, already constructed, or hereafter to be constructed, or of his agent, or of the occupant or person in possession, charge or control of the same, to affix and display conspicuously on each floor of such building a placard stating the load per square foot of floor surface which may with safety be applied to that particular floor, or if the strength of different parts of any floor varies, then there shall be such placards for each varying part of such floor. It shall be unlawful to load any such floors, or any part thereof, to a greater extent than the load indicated upon such placards. It shall be the duty of occupants of buildings to maintain such placards during their occupation of the premises, and the owners of buildings, or their agents, to cause the same to be properly affixed with each change of occupation. It shall be part of the duty of architects of all buildings to calculate the figures for such placards, which are to be verified and approved by the Commissioner of Buildings before they are affixed upon the respective floors of the different buildings.

Walls.—Ledges.—See Section 588.

Walls.—Around Stairs, Elevators and Shafts. See Section 588.

Walls.—Reinforced concrete. See Section 554.

Towers.—Domes.—Spires.—See Section 613.

ARTICLE V.

PROVISIONS RELATING SOLELY TO CLASS II.

In Class II, shall be included every office building, every hospital and every building used for hotel purposes, or for boarding or lodging house purposes, where such building so used for hotel, hospital or boarding or lodging house purposes is occupied by twenty or more persons.

Sec. 269. (**Walls of Class II.**)—The thickness of the walls of buildings of Class II, shall conform to the following requirements:

The thickness of the enclosing walls of buildings of this class shall be made in accordance with the following table, to-wit:

	STORIES											
	Basement.	1	2	3	4	5	6	7	8	9	10	11 12
Basement and	12	8										
Two-story	12	12	8									
Three-story	16	12	12	12								
Four-story	20	16	16	12	12							
Five-story	20	16	16	16	12	12						
Six-story	20	20	16	16	16	12	12					
Seven-story	24	24	20	20	16	16	12	12				
Eight-story	24	24	24	20	20	16	16	12	12			
Nine-story	28	24	24	20	20	20	16	16	12	12		
Ten-story	28	24	24	24	20	20	20	16	16	12	12	
Eleven-story	28	28	24	24	24	20	20	20	16	16	12	12
Twelve-story	32	28	28	24	24	24	20	20	20	16	16	12 12

Provided, however, in buildings of steel skeleton fireproof construction, thickness of walls shall be governed by the provisions of Section 510 of this chapter.

Sec. 270. (**Buildings.—Construction Of.—Height Of.**)—Buildings of Class II. which are one hundred feet or more in height shall be built entirely of fireproof construction.

Buildings of Class II. less than one hundred feet and more than sixty feet in height shall be built entirely of slow-burning, or mill or fireproof construction. Buildings of Class II. not exceeding four stories in height and less than sixty feet in height may be built of ordinary construction.

Sec. 271. (**Walls.—Division and Partitions in Boarding or Lodging Houses and Hotels.**)—In buildings used wholly or in part for boarding houses, lodging houses or hotels, sixty feet or less in height, there shall be for every eight rooms in any one story dividing walls or partitions of incombustible material, separating such eight rooms from the contiguous spaces. Partitions surrounding stairs and corridors shall be made of fireproof material.

Sec. 272. (**Stairs in Buildings of Class II.**)—Stairs in Buildings of Class II. shall be adapted, in number and width, to the area, height and to the uses to be made of the building in which they occur.

For office buildings, by which shall be understood buildings divided into apartments intended for business uses only, and in which there shall be no sleeping apartments whatever, there shall be in buildings of ordinary construction and of less ground area than three thousand square feet, two flights of stairs not less than three feet wide each; for office buildings of ordinary construction and of greater floor area than three thousand square feet, there shall be six inches added to the width of each such flight of stairs for each additional one thousand feet of floor area, or fractional part thereof, up to six thousand square feet of floor area; for office buildings of ordinary construction and of greater floor area than six thousand square feet, there shall be an additional flight of stairs not less than three feet wide for each additional three thousand square feet of floor area, or fractional part thereof.

For office buildings of slow-burning or mill construction there shall be at least two flights of stairs three feet wide each for the first four thousand square feet of floor area, and there shall be six inches added to the width of each such flight of stairs for each additional one thousand square feet of floor area, or fractional part thereof, up to eight thousand square feet of floor area; and an additional flight of stairs not less than three feet wide shall be required for each additional four thousand square feet of floor area, or fractional part thereof, above eight thousand square feet.

For fireproof office buildings there shall be required one flight of stairs not less than four feet in width for the first three thousand square feet of floor area, or fractional part thereof.

For fireproof office buildings of more than three thousand, and not exceeding five thousand square feet of floor area, there shall be required one flight of stairs not less than five feet in width.

For more than five thousand and less than ten thousand square feet of floor area there shall be required an additional flight of stairs not less than three (3) feet in width.

For more than ten thousand and less than twenty thousand square feet of floor area there shall be required two flights of stairs of not less width than five (5) feet each; provided, that for each and every fireproof office building of more than ten thousand square feet floor area there shall be at least two stairway fire escapes, placed as

far apart as practicable, on such buildings, in addition to the standpipe and platform fire escape required by this chapter and the statutes of this state.

An additional flight of stairs shall be required for each additional ten thousand square feet of floor area; provided, that for each additional five thousand square feet of floor area such stairway shall be not less than three feet wide.

And for additional floor areas between five thousand and ten thousand square feet such stairway shall be not less than five feet in width. The width of the different stairways need not be the same.

Sec. 273. (Hospitals, Hotels, Boarding or Lodging Houses.—Stairways.—Fire Stops.)—For all buildings of Class II. of ordinary construction used as hotels, boarding or lodging houses, or hospitals, there shall be required for each building at least two flights of stairs, which, for buildings of three thousand square feet or less in floor area, shall be of not less width than three feet each, with an increase of six inches in width for each additional one thousand square feet of floor area, or fractional part thereof, up to a floor area of five thousand square feet; and after that there shall be an additional flight of stairs not less than three feet wide for each additional two thousand feet of floor area, or fractional part thereof.

For all buildings of Class II. of slow-burning or mill construction used as hospitals, hotels, boarding or lodging houses, there shall be required for each building at least two flights of stairs, which, for buildings of four thousand square feet or less in floor area, shall be of not less width than three feet each, with an increase of six inches in width for each additional one thousand square feet of floor area, or fractional part thereof, up to a floor area of six thousand square feet; and after that there shall be an additional flight of stairs not less than three feet wide for each additional three thousand feet of floor area, or fractional part thereof.

For all buildings of Class II. of fireproof construction used as hospitals, hotels, boarding or lodging houses, there shall be required for each building at least two flights of stairs, which, for buildings of five thousand square feet or less in floor area, shall be of not less width than three feet each, with an increase of five inches in width for each additional one thousand square feet of floor area up to a floor area of ten thousand square feet, and there shall be required an additional flight of stairs not less than three feet wide for each additional four thousand square feet of floor area, or fractional part thereof.

Each stairway in the fifth, sixth, seventh and eighth stories may be built six (6) inches less in width in the clear than the stairways in the first to the fourth stories, inclusive.

Each stairway in the ninth, tenth, eleventh and twelfth stories may be built twelve (12) inches less in width in the clear than the stairways in the first to the fourth stories, inclusive.

Each stairway in the thirteenth, fourteenth, fifteenth and sixteenth stories may be built eighteen (18) inches less in width in the clear than the stairways in the first to the fourth stories inclusive, and this reduction in width may be continued in the same ratio in each additional four (4) stories added to the height of the building; provided, however, that no stairways shall have a less clear width than three (3) feet.

All stairways in buildings of Class II. shall have a hand rail on each side thereof, and where there is more than one flight of stairs in any building of Class II., such stairways shall be located at each end of the building, or as far apart from each other as is practicable.

In hotels, hospitals, lodging houses or boarding houses, of other than fireproof construction, there shall be a fire stop of brick, concrete or tile, between the ceiling and floor in each floor of joists for each twenty-five feet, or fractional part thereof, measured in the direction of the length of the joists.

Sec. 274. (Air.—Means of Communication With Outer Air in Buildings of Class II.)—Amended by ordinance of Oct. 22, 1906, to read as follows:

In all buildings of this class, the fire escape, stairs, stair halls, entrance halls, bay windows, vent shafts, courts, lights in halls, porches, windows in public halls, shall be of the size and dimensions as are prescribed in Sections 392, 400, 402, 404, 412, 415, 416, 417, 418, 419, 420, 421, 422, and 423 of this chapter relating to buildings of Class I'1.

Where vent shafts as defined in Section 389 of this ordinance, are used to ventilate water closet compartments, bath rooms, or pantries, of hotels, office buildings, or club houses, they shall be of the following dimensions:

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Building	Square feet	Least width
2 stories	22½	3 feet
3 stories	27	3 feet
4 stories	36	3 feet
5 stories	48	5 feet
6 stories	72	6 feet
7 stories	96	8 feet
8 stories	120	8 feet

In every hotel, office building, or club house, hereafter erected, and every hotel, office building, or club house, which shall be increased or diminished in size, or otherwise altered after its erection, and in every building, now or hereafter in existence, not now used as a hotel, office building or club house, but hereafter constructed or altered to such use, and every habitable room, excepting water closet compartments, bathrooms and pantries, shall have at least one window opening directly upon a street, alley, yard, or court. The total area of the windows opening from any such room (other than water closet compartments, bathrooms and pantries), shall be, at least one-tenth the floor area of that room, and the top of, at least, one window shall be not less than seven feet above the floor, and the upper half of that window shall be made so as to open its full width. No window in any such room (other than pantries, water closet compartments and bath rooms), shall have less than ten square feet of glass area. Every such water closet compartment, bathroom or pantry, shall have a window not less than one foot wide and of an area of, at least, four square feet for a floor area of forty-five square feet or less opening directly into the outer air, or special light or air shafts, into which no other rooms, or compartments, other than toilet compartments, bathrooms, or pantries, are ventilated. For upwards of forty-five square feet of floor area there shall be a window area of at least one-tenth of the floor area. The windows in all cases shall be arranged so as to admit of their being opened at least one-half of their height. The urinal, bath or water closet compartments on the top floor of any building may be lighted and ventilated by means of a skylight and ventilator. The area of the skylight shall conform to the above specified areas for windows.

It is provided that in hotels, office buildings and club houses, the bathroom, water closet and urinal compartments, may be ventilated by exhausting the air from the same at the rate of at least six complete changes of air from each room per hour by approved positive mechanical means through special air ducts to the outer air. The special ventilating duct or ducts, together with their branches, shall be of such size or sizes as to provide for the required changes of air from each of such rooms.

It shall be the duty of the owner, agent, architect, or of the party in possession or control of the same to notify the Commissioner of Health in writing twenty-four hours in advance when any such system is completed, for the supervision of the test.

When the installation of the mechanical ventilating system for toilet and bathrooms is complete, and the ventilating appliances are being operated at their normal capacities, they shall be tested by the party notifying for test for volumetric efficiency in the presence of, and under the direction of, the Chief Sanitary Inspector of the Department of Health.

The mechanical ventilating system shall at all times be kept in good repair and in operation to insure the required ventilation during the hours when the above specified buildings are used for human occupancy.

All such toilet or bathrooms as mentioned in this section, shall have a fixed window, or windows, having a gross glass area and equal to at least one-eighth of the floor area of rooms. The windows are to be provided and placed in the dividing or enclosing partitions, and shall be suitably arranged so as to admit of natural light from an adjoining room which has direct communication to the outside air. All such rooms or compartments shall have proper means for artificially lighting the same, and they shall be properly and adequately lighted by natural or artificial means during the occupancy of the building.

Sec. 275. (Joists.—Supports For.)—If in buildings of Class II. the distance between the enclosing walls is more than twenty-four feet in the clear, there shall be intermediate supports for the joists, which supports shall be either brick walls or iron or steel columns and beams or trusses or girders. If brick walls are used for this purpose, they may, in all cases where the thickness of walls is given in the table as sixteen inches or more, be made four inches less in thickness than the dimensions stated in the table.

Sec. 276. (Loads.—Allowance for Live Loads in Construction of Floors of Class II.)—For all buildings of Class II. the floors shall be designed and constructed in such manner as to be capable of bearing in all their parts, in addition to the weight of the floor construction, partitions and permanent fixtures and mechanisms that may be set upon the same, a live load of fifty pounds for every square foot of surface in such floors.

Sec. 277. (Stalls or Rooms of Class II.—When Considered Habitable.)—In buildings of Class II. no room shall be considered habitable or used as a habitation unless it has at least one window of an area equal to one-tenth of the superficial area of such room, opening into the external air. Provided, however, that no stall or compartment used as a sleeping room in a building, the walls of which stall or compartment do not extend within a distance of two and one-half feet from the ceiling thereof, shall be regarded and considered to be a room within the intent and meaning of the provisions hereof, but the walls of every such stall or compartment shall be of incombustible material.

Sec. 278. (Hospitals.—Construction.—Height Of.—Permits.—Special Consents.)—It shall be unlawful for any person or corporation to build, construct, maintain, conduct or manage in any block, if two-thirds of the buildings fronting upon both sides of the streets bounding such block or square are devoted chiefly to residence purposes, any hospital for the care, treatment or nursing of three or more insane persons; or any hospital for the care, treatment or nursing of three or more inebriates, or persons suffering from the effect of the excessive use of alcoholic liquors; or any hospital for the care, treatment or nursing of three or more epileptics; or any hospital for the care, treatment or nursing of three or more persons addicted to, or suffering from, the excessive use of morphine, cocaine or other similar drugs or narcotics; or any hospital for the care, treatment or nursing of any person affected with any infectious or contagious disease, unless the owners of a majority of the frontage in such block or square, and in addition thereto the owners of a majority of the frontage on the opposite sides of the streets bounding such block or square, consent in writing to the building, constructing, maintaining, managing or conducting of any such hospital in such block or square. Such written consents of the majorities of such property owners shall be filed with the Commissioner of Buildings, and an exact copy of same shall be filed with the Commissioner of Health before a permit shall be granted for the building or constructing, or a license issued for the maintaining, conducting or managing of any such hospital. Provided, that any building that may be used for hospital purposes which is over two stories in height shall be of fireproof construction throughout, and no hospital shall be built to exceed six stories in height.

Sec. 279. (Hospitals.—Location of Near School Houses.)—No hospital of any kind or description hereafter erected or established shall be erected or established within four hundred feet of property used for school purposes.

(Walls.—Ledges.—Joist Supports.)—All ledges in walls shall be as specified in Section 588 of this chapter.

Walls.—Reinforced concrete. See Section 554.

Sec. 280. (Roofs.—Strength Of.)—The roofs of buildings of Class II. shall be designed and constructed as is required in Section 610.

Roofs.—Shingle.—See Section 609.

Towers, Domes and Spires.—Construction Of.—See Section 613.

Skylights.—Construction, Glass In. See Section 614.

Bay Windows and Light Shafts.—Material for. See Section 600.

Doors and Windows.—When required to be closed.—Fire resisting glass. See Section 632.

Wind Pressure.—Precautions against. See Section 603.

Windows.—Cleaning, safety devices. See Section 726.

Buildings Used for the Purposes of More than One Class.—See Section 249.

Limitations in Changing Class of Buildings.—See Section 633.

Walls.—Around Stairs, Elevators and Shafts.—See Section 588.

ARTICLE VI.

PROVISIONS RELATING SOLELY TO CLASS III.

In Class III. shall be included every building used as a family residence; also every building used for stabling purposes, where such building so used shall occupy a ground area of less than five hundred square feet.

Section 281. (Walls of Class III.—Thickness of.)—Buildings of Class III. shall conform to the following requirements:

The thickness of enclosing walls of buildings of this class shall be in accordance with the following table, to wit:

		STORIES											
	Basement.	1	2	3	4	5	6	7	8	9	10	11	12
Basement and	12	8											
Two-story	12	12	8										
Three-story	16	12	12	12									
Four-story	20	16	16	12	12								
Five-story	20	16	16	16	12	12							
Six-story	20	20	16	16	16	12	12						
Seven-story	24	24	20	20	16	16	12	12					
Eight-story	24	24	24	20	20	16	16	12	12				
Nine-story	28	24	24	20	20	20	16	16	12	12			
Ten-story	28	24	24	24	20	20	16	16	12	12			
Eleven-story	28	28	24	24	24	20	20	16	16	12	12		
Twelve-story	32	28	28	24	24	24	20	20	20	16	16	12	12

Provided, however, in buildings of steel skeleton fireproof construction, thickness of walls shall be governed by the provisions of Section 510 of this chapter.

Sec. 282. (Buildings.—Construction Of.—Height Of.)—Buildings of Class III. which are one hundred feet or more in height shall be made entirely of fireproof construction.

Buildings of Class III. less than one hundred feet and more than sixty feet in height shall be built entirely of slow-burning mill or fireproof construction.

Buildings of Class III. less than sixty feet in height may be built of ordinary construction.

Sec. 283. (Skylights.—Construction Of.—Glass In.)—The skylight on the roof of any building of Class III., other than a frame building, shall have the sides, sashes and frames constructed of metal, or of wood metal clad on all exterior surfaces. If the building exceed three stories in height, such skylight shall have at least six inches over same a strong wire netting (wire not lighter than No. 8 and mesh not coarser than $1\frac{1}{2} \times 1\frac{1}{2}$ inches), unless the glass contains a wire netting within itself.

Sec. 284. (Loads.—Allowance for Live Loads in Construction of Floors of Class III.)—For all buildings of Class III. the floors shall be designed and constructed in such manner as to be capable of bearing in all their parts, in addition to the weight of floor construction, partitions and permanent fixtures and mechanisms that may be set upon the same, a live load of forty pounds for every square foot of surface in such floors.

Sec. 285. (Rooms of Class III.—When Considered Habitable.)—In buildings of Class III., no room shall be considered habitable or used as a habitation unless it has at least one window of an area equal to one-tenth of the superficial area of such room opening into the external air.

Sec. 286. (Fire Walls.—Thickness Of.—When Dispensed With.)—In buildings of Class III., fire walls of brick not less than twelve inches thick shall be built, extending above the roof thereof, if such roof is flat, and also above the roof of such building where the same abuts against another building, or where the same stands upon any line of any lot, excepting street or alley lines. Provided, that where eight-inch walls are permitted in the top story of buildings, or where the building is not over three stories high, the fire walls may be eight inches thick. Such fire walls, where they stand upon lot lines or where they are over the dividing walls between buildings, or over the dividing walls in the interiors of buildings, where such are required by the provisions of this chapter by reason of the great area of such buildings, shall extend at least two feet above the roof of such buildings. Fire walls upon street and alley lines shall extend not less than eighteen inches above the roofs of such buildings. Fire walls may be dispensed with on street and alley lines, if the tops of the roof boards and roof joists are protected against fire for a distance of at least five feet from such street or alley lines by a coating of mortar or hollow tile or porous tile at least two inches thick. Fire walls at street and alley lines may also be dispensed with in all cases where the entire framing and material of the roof is made strictly fireproof.

Walls facing upon courts and light shafts shall be treated as in the same category with walls facing upon streets and alleys.

Fire walls shall be covered with a weatherproof coping of incombustible material.

Sec. 287. (Bay Windows and Light Shafts.—Material For.)—Bay or oriel windows and light shafts may be built of combustible material in buildings of Class III. of two stories or less in height, provided, such bay and oriel windows or light shafts shall not have a greater width than twelve feet at wall line of building, and, provided, that the outside walls, roofs and soffits of such bay or oriel windows and light shafts, when so constructed, shall be covered with sheet metal or other incombustible material. In all other cases, bay and oriel windows and light shafts and their supports shall be constructed entirely of incombustible material.

Sec. 288. (Walls.—Brick Wall Upon Wooden Sills.—Level of Sills Allowed.)—All buildings of Class III. not exceeding one story in height and twenty feet in height from top of sills to highest point of roof, and with side walls not exceeding fourteen feet in height, and with floor area not exceeding one thousand two hundred square feet, may have brick walls not less than eight inches in thickness erected on wooden sills, the sills supported on iron, masonry or concrete supports extending four feet below the surface of the ground. The foundations under such supports shall be of concrete, stone or brick, each covering not less than five square feet area and not more than eight feet apart to support the weight that may rest upon them with safety; sills shall be placed not higher than four feet above the established grade of the street upon which the lot fronts, and upon which lot the building is erected, where grades are established, and not exceeding seven feet above the ground where grades are not established. In all cases of buildings being more than one story and less than two stories high, and having a gable or hip roof of not less than one-third (1-3) pitch, 8-inch walls on solid brick or stone masonry may be used, provided they do not exceed 14 feet in height measured from the first floor joist, and provided such buildings have a floor area not exceeding one thousand two hundred (1,200) feet, and are not over twenty-two feet in width.

Roofs.—Strength Of. See Section 610.

Roofs.—Shingle and Gravel. See Section 609.

Wind Pressure. Precautions against. See Section 603.

Walls.—Reinforced Concrete. See Section 554.

Walls.—Ledges. See Section 588.

Towers, Domes and Spires. See Section 613.

Limitations in Changing Class of Buildings. See Section 633.

ARTICLE VII.

PROVISIONS RELATING SOLELY TO CLASS IV.

In Class IV. shall be included every building used as an assembly hall, whether such hall is used for the purpose of worship, instruction or entertainment, unless such building is used for any of the purposes for which buildings of Class V. or Class VIII. are used.

Sec. 289. (Walls.—Outside Walls of Class IV.—Structures Built Above.—Walls Of.)—The outside walls of every building used wholly or in part for the purposes of Class IV., the roof or ceiling of which is carried on trusses or girders of a span of fifty feet or more, shall be as follows:

If such walls are less than twenty-five feet high, not less than twenty inches thick.

If they are more than twenty-five feet high and less than forty-five feet high, they shall not be less than twenty-four inches thick.

If they are more than forty-five feet and less than sixty feet high, they shall not be less than twenty-eight inches thick.

If they are more than sixty feet and less than seventy-five feet high, they shall not be less than thirty-two inches thick.

If they are more than seventy-five feet and less than ninety feet high, they shall not be less than thirty-six inches thick.

An increase of four inches in thickness of such walls shall be made in all cases where they are over one hundred feet long without cross walls of equal height.

Walls around stairs, elevators and shafts. See section 588.

For rooms used for the purposes of Class IV., where such rooms are less than fifty feet wide in the clear, the thickness of the walls enclosing or surrounding such rooms may be reduced by four inches.

The outside walls of every building of Class IV., the roof or ceiling of which is not carried on trusses or girders, shall be of the same thickness as in buildings of Class I.

If one or more stories are built above the room or rooms, or portion of any such building devoted to the uses of Class IV., and such stories are carried on trusses or girders, the thickness of walls shall be increased by four inches for each two stories or part thereof above every such room.

If solid masonry buttresses are employed, and placed eighteen feet or less apart, and extended to the foot of the trusses or girders carrying the ceiling, or if iron or steel pillars are inserted in such walls for the support of the superstructure, and at distances not more than twenty-four feet between centers, and if such pillars extend to and carry the superimposed trusses and girders, the thickness of such walls may be reduced in proportion to the increase of strength afforded by such buttresses or pillars; but in no case shall any such wall be less than twelve inches thick in the top story; four inches shall be added, going downward, for each story, or for each twenty-five feet in height of wall. Provided, that if in any building of this class

now in existence the structural parts thereof do not comply with the foregoing requirements, and structural changes are made therein, then all walls, columns or other structural parts shall be strengthened in a manner satisfactory to the Commissioner of Buildings.

Sec. 290. (Walls.—Columns In.)—If iron or steel columns are introduced in such walls, the brickwork around the same shall be bonded into that of the connecting walls, and each of such columns shall be fireproofed, as provided in Section 511 of this chapter.

Sec. 291. (Frontage of Class IV. Seating Less Than 800.)—Buildings of Class IV., containing halls or rooms of an aggregate seating capacity of eight hundred persons or less, shall have for each hall or room a frontage upon two public spaces, of which at least one shall be a street, and of which the other, if it is not a street, shall be a public or private alley, not less than ten feet wide, opening directly on a public street.

Sec. 292. (Frontage of Class IV.—Seating Over 800.)—Buildings of Class IV., containing halls or rooms used for the purposes of Class IV. of greater aggregate seating capacity than eight hundred, shall have for each such hall or room a frontage upon three open spaces, of which at least one shall be a public street, while the two others, if not streets, shall be public or private alleys of a width of not less than ten feet each, opening directly on a public street, or fireproof passageways or tunnels of not less than seven feet each in width may be used in place of these alleys, provided, such passageways or tunnels lead to a public thoroughfare.

Sec. 293. (Buildings, Class IV.—Construction Of.)—Amended Dec. 11, 1905, to read as follows:

Buildings of Class IV., containing halls of an aggregate seating capacity of not more than eight hundred, may be built of ordinary construction. If such halls have a greater aggregate seating capacity than eight hundred (800) and less than one thousand five hundred (1,500), such building shall be built of mill, slow-burning, or fireproof construction. If such hall have an aggregate seating capacity of one thousand five hundred (1,500) or more, such buildings shall be built entirely of fireproof construction, provided that buildings mainly used for exposition or exhibition purposes, and not exceeding two stories in height, or having for public use only a main floor and one gallery, and which have their outside walls and structural members of incombustible material and which comply in all other respects with this ordinance, may have their temporary seats, boxes, show-cases, platforms, or booths, constructed of combustible material.

In computing the seating capacity of any room or building used for the purposes of Class IV., in which the seats are not fixed, an allowance of eight square feet of floor area shall be made for each person, and all space between the walls or partitions of such room or building shall be measured in this computation. *Provided, that in church buildings not having more than two stories and each floor having its own separate exits and standing free from all buildings, the seating capacity of each floor shall be estimated alone as determining the kind of construction under this article.*

Distance of said building from any other structure or building, to be at least seven feet on all sides.

As amended February 4, 1907.

Sec. 294. (Buildings of Class IV., Used Partly for Other Purposes.)—Any building occupied wholly or in part for the purposes of Class IV., shall be built entirely of fireproof construction, if the halls or rooms used for the purposes of Class IV. therein have an aggregate seating capacity greater than one thousand five hundred.

Sec. 295. (Buildings of Certain Height.—Construction Of.)—Any building higher than sixty feet and connected with or made part of any building used wholly or in part for the purposes of Class IV., shall be entirely of fireproof construction. Any such building less than sixty feet in height shall, if its case is not already covered by other provisions of this chapter, be made of fireproof, slow-burning or mill construction.

Sec. 296. (Opening Between Non-Fireproof Buildings.)—In all cases where fireproof construction is not used for the whole of two or more connected buildings, used wholly or in part for the purposes of Class IV., there shall be at each connecting opening double iron doors.

Sec. 297. (Spires, Cupolas and Domes Upon Houses of Worship.—Violation.—Spires, etc., to be Taken Down.—Roofs of Isolated Buildings of Class IV.)—Spires, cupolas or domes with a framework of non-fireproof material and covered on the outside with incombustible material, may be erected as part of any house of public worship, and if such house of worship is so built that it is nowhere nearer than twenty feet to any line of the lot upon which it stands (street and alley lines excepted), such non-fireproof spires, cupolas or domes may be maintained only while this intervening space of twenty feet is maintained unoccupied as part of the grounds

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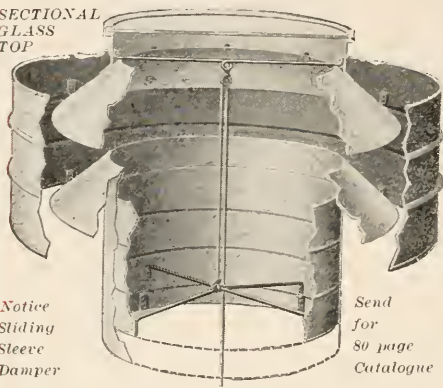
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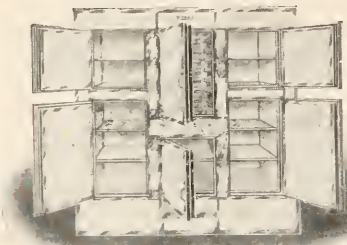
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or premises belonging to such house of public worship. If the conditions of such building be so changed that there shall not be a vacant space as hereinbefore required surrounding same, such spire, cupola or dome shall be forthwith taken down.

The roofs of isolated buildings, occupied for purposes of Class IV., shall be constructed in the same manner as that provided for spires, domes and cupolas.

Provided, however, that the roofs of houses of worship outside the fire limits not exceeding twenty-eight hundred square feet in area may be covered with shingles.

Sec. 298. (Floor Levels.—Limitation of Floor Levels of Class IV.—Auditorium Floor of Class IV.—Height Above Sidewalk.—Stairs.)—The following limitations of floor levels in buildings occupied either wholly or in part for purposes of Class IV. shall be observed in all cases.

In buildings occupied either wholly or in part for purposes of Class IV., no auditorium of a greater seating capacity than one thousand shall have the highest part of its main floor at a greater distance than ten feet above the adjacent sidewalk grades. No room or rooms used for the purposes of Class IV., of greater seating capacity than five hundred, shall be at a greater distance above the sidewalk grade than thirty feet. No room or rooms used for the purpose of Class IV., of greater seating capacity than two hundred, shall be at a higher level above the sidewalk grade than forty-five feet.

Provided, however, that in the case of a building used either wholly or in part for the purposes of Class IV., and built wholly of fireproof construction, a room or rooms to be used for the purposes of Class IV., and of an aggregate seating capacity of less than five hundred, may be located in any story thereof, but in such case there shall be at least two separate and distinct flights of stairs from the floor or floors in which such room or rooms are located to the ground, each of which stairs shall be not less than four feet wide in the clear.

Sec. 299. (Loads, Allowance for Live Loads in Construction of Floors of Class IV.—Stairways.—Entrances and Exits, Width Of.)—All floors of all buildings of Class IV. shall be designed and constructed in such a manner as to be capable of bearing in all their parts, in addition to the weight of floor construction, partitions and permanent fixtures and mechanisms that may be set upon the same, a live load of one hundred pounds for every square foot of surface in such floor. The width of stairways in buildings used wholly or in part for the purposes of Class IV. shall be eighteen inches for every one hundred of the aggregate seating capacity of all rooms in such building, which are used for the purposes of Class IV., and for fractional parts of each one hundred seating capacity a proportionate part of eighteen inches shall be added to the width of such stairways, but no stairway in such building shall be less than four feet wide in the clear, except as hereinafter provided; and provided, further, that in any such building having a room or rooms used for purposes of Class IV., the aggregate seating capacity of which shall not exceed two hundred and fifty persons, two separate and distinct three-foot stairways shall be permitted.

All stairways shall have hand railings on each side thereof. Stairways which are over 7 feet wide shall have double intermediate handrails, with end newel posts at least 5½ feet high. No stairways shall ascend a greater height than thirteen feet six inches without a level landing, which, if its width is in the direction of the run of the stairs, shall not be less than three feet wide, or which, if at a turn of the stairs, shall not be of less width than the width of the stairs.

Stairways leading to a box or boxes, seating not to exceed thirty people in the aggregate, shall be independent of all other stairs or seats and not less than two feet six inches wide in the clear. For each additional twenty-five of seating capacity, or major portion thereof, in such boxes, an additional width of five inches shall be added to such stairways.

(Walls.—Ledges.)—See Section 588.

(Doors and Windows.—When Required to Be Closed.—Fire-Resisting Glass.)—See Section 632.

Sec. 300. (Balconies and Galleries.—Exit and Entrance.)—Distinct and separate places of exit and entrance shall be provided for each gallery. A common place of exit and entrance may serve for the main floor of the auditorium and the balcony, provided its capacity be equal to the aggregate capacity of all aisles or corridors leading from the main floor and such balcony to such place of exit and entrance.

Sec. 301. (Balconies and Galleries.—Designation Of.)—Where there are balconies or galleries, the first balcony or gallery shall be designated the "Balcony," and the second and third balcony or gallery shall be designated, respectively, "Gallery" and "Second Gallery." Such designation shall be plainly printed on all admission tickets.

Sec. 302. (Aisles.—Steps in Aisles.—Passageways.—Kept Unobstructed.—Width of Corridors, Passages, Hallways and Doors.)—Aisles in rooms or auditoriums used for the purposes of Class IV. shall in the aggregate be eighteen inches in width for each one hundred of the seating capacity of such room or auditorium, and for fractional parts of one hundred, a proportionate part of eighteen inches shall be added; but no aisle shall be less than two feet and six inches in width in its narrowest part.

Steps shall be permitted in aisles only as extending from bank to bank of seats, and whenever the rise from bank to bank of seats is less than five inches the floor of the aisles shall be made as an inclined plane, and where steps occur in outside aisles or corridors, they shall not be isolated, but shall be grouped together and there shall be a light so placed as to illuminate such steps in such outside aisles or corridors. All aisles and passageway in such rooms or auditoriums shall be kept free from camp stools, sofas, chairs and other obstructions, and no person shall be allowed to stand in or occupy any of such aisles or passageways during any performance, service, exhibition, lecture, concert, ball, or any public assembly.

Sec. 303. (Corridors, Passageways, Hallways and Doors.—Width of.)—The Width of corridors, passageways, hallways and doors adjacent to, connected with or a part of such rooms or auditoriums, shall be computed in the same manner as is herein provided for stairways and aisles, excepting, however, that no such corridor, passageway or hallway shall be anywhere less than four feet in width, and no such door shall be less than three feet in width.

Sec. 304. (Seats.—Number of in Rows.)—There shall not be more than fourteen seats in any one row between aisles.

Rows of seats shall not be less than 2 feet 8 inches from back to back, and no bank of seats shall be of greater rise than 24 inches.

Sec. 305. (Emergency Exits.)—Emergency exits and stairways shall be provided outside of the walls of all assembly halls of a larger seating capacity than eight hundred. Provided, however, that if any such assembly hall is used for any of the purposes described in Section 311 of this chapter, and has a seating capacity of more than four hundred, such assembly hall shall have emergency exits to the street of one-half the aggregate width of the main exits, but no such emergency exit shall be less than three feet in width.

Such emergency exits and stairways therefrom may be built inside the walls of the building in a corridor or passageway not less than seven feet wide, which corridor or passageway shall be surrounded by a fireproof partition, not less than four inches thick.

Such stairways shall be made of wrought iron or steel, or other approved fireproof material and cast iron is not approved for this work. All emergency exits and stairways therefrom shall be kept free from obstruction of any kind, including snow and ice.

Sec. 306. (Doors to Open Outward.)—All doors affording access directly or indirectly to the street from any room used for the purposes of Class IV. shall open outward upon suitable hinges.

Exit doors from such rooms shall not be obscured by draperies and shall not be locked, or fastened, in any manner during the entire time any such room is open to the public, but shall be so constructed and maintained that they may be easily opened from the interior.

Sec. 307. (Walls Between Auditorium and Stage.)—In buildings used either wholly or in part for the purposes of Class IV. hereafter erected, there shall be a solid brick wall, of the same thickness as that called for on the outside walls, between the auditorium and stage; and in non-fireproof buildings such walls shall extend to a height of three feet above the roof. Provided, however, that in existing buildings, any room used for the purposes of Class IV., and having a seating capacity greater than four hundred, shall have the proscenium wall built of incombustible material.

Sec. 308. (Curtain Shall Be Iron, Steel or Asbestos.—Inspection Of.—Fee.)—The main curtain opening in any such room shall have a wrought iron or steel or asbestos curtain, which shall be inspected by the building department semi-annually, for which inspection a charge of two dollars shall be made, and all other openings in the proscenium wall shall have self-closing iron doors.

Sec. 309. (Structures Over Ceiling.—Construction.)—If any structure is built over the ceiling or roof of any building used either wholly or in part for the purposes of Class IV., the different members of the girders or trusses supporting same shall have their fireproofing double, in the manner required for columns for fireproof buildings of Class I.

Sec. 310. (Fire Apparatus on Stage.)—In all rooms used for the purpose of Class IV. of a seating capacity of two hundred and fifty or more, where stationary

scenery is used, there shall be kept for use two or more portable fire extinguishers or hand fire pumps on and under the stage, and also four fire department axes, two fifteen-foot hooks and two ten-foot hooks on each tier or floor of the stage, subject to the approval of the Fire Marshal, and in such rooms of less seating capacity than two hundred and fifty, there shall be at least one portable fire extinguisher.

Sec. 311. (Rooms Used for Regular Theatrical or Vaudeville Performances.—Exit Doors.)—Exit doors shall not be obscured by draperies and shall not be locked or fastened in any manner during the entire time any such room of Class IV. is open to the public, so as to prevent them from being easily opened outwardly; and such doors shall be so constructed and maintained, as to require no special knowledge or effort to open them from the interior.

It shall be the duty of every person, or corporation, operating or maintaining any room, having a seating capacity of three hundred or more, used for the purposes of Class IV., and which is used regularly for theatrical or vaudeville performances and where an admission fee is charged, to employ one competent, experienced fireman, who shall be detailed by the Fire Marshal, and who shall be in the uniform of the Chicago Fire Department. Such fireman shall be on duty during the whole time such room is open to the public, and he shall report to and be subject to the orders of the Fire Marshal; he shall see that all fire apparatus required by this chapter is in its proper place and in proper condition ready for use, and that all exits are unlocked during the whole time such building is open to the public.

Such fireman and the Fire Marshal shall require all persons employed in or about such room to be drilled in the use of all apparatus and appliances for the prevention of fire installed therein, at least twice in every week, and such fireman shall report to the Fire Marshal the manner and efficiency of such drill. Such fireman shall report in writing daily to the Fire Marshal the condition and equipment of the building, or portion thereof, to which he is detailed. No fireman shall be on duty at any one building for a longer period than two weeks.

Sec. 312. (Standpipe and Hose on Stage.)—A standpipe not less than one and one-half inches in diameter, with a hose connection and hose valve therein, shall be installed on each side of the stage in such room, and shall at all times have a hose connected thereto, ready for use.

Such standpipe shall be connected with a power pump or gravity tank so that a sufficient pressure of water shall be furnished through such standpipe to afford adequate fire protection. The pressure to be furnished by such tank or pump shall be satisfactory to the Fire Marshal.

Sec. 313. (Vents or Flue Pipes.)—One or more vents or flue pipes of metal construction or other incombustible material approved by the commissioner of buildings shall be built over the stage, and shall extend not less than ten feet above the highest point of the roof, and shall be equivalent in area to one-twentieth of the area of the stage.

In buildings where additional stories are built above the stage, such vents or flue pipes may be carried out near the top of the stage walls, and shall be continued and run up on the exterior of the building to a point five feet above the highest point of the additional stories.

All such flues or vents shall be provided with metal dampers, and shall be opened by a closed circuit battery, approved by the City Electrician.

Such dampers shall be controlled by two switches, one at the Electrician's station on the stage, which station shall be fireproof, and the other at the city fireman's station on the opposite side of the stage; such switches shall be located in such places on the stage as may be designated by the Fire Marshal, and each switch shall have a sign with plain directions as to the operation of same printed thereon.

Sec. 314. (Fuse Boxes.)—All fuse boxes shall be surrounded by two thicknesses of fireproof material, with an air space between, and no fuse shall be exposed to the air between the switchboards; all electrical equipment in such rooms shall be installed and maintained to the satisfaction and approval of the City Electrician.

Sec. 315. (License.)—The amusement license for each room used for the purposes of Class IV. shall state the number of persons such room has accommodations for, which number shall be governed by the provisions of this chapter relating thereto, and no more than that number shall be allowed to be in such room at any one time.

No amusement license shall be issued for any room used for the purposes of Class IV. unless the Commissioner of Buildings, the Fire Marshal and the City Electrician shall first have certified, in writing, that such room complies with the provisions of this chapter in every respect.

Sec. 316. (Exits.—Diagram of, Printed on Programs.—Signs Over.)—It shall be the duty of the owner, lessee, or manager of every room used for the purposes

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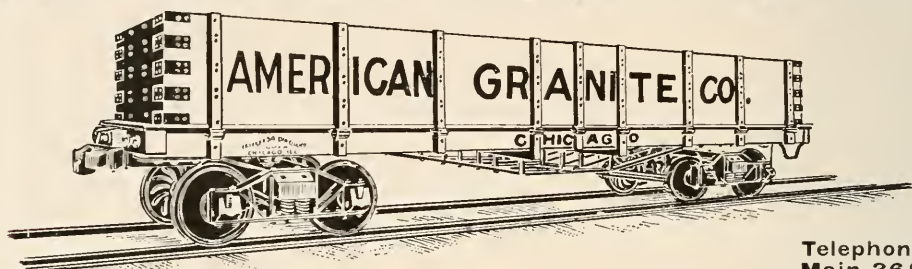
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of Class IV., and in which programs are issued for performances given therein, to cause to be printed on such programs a diagram showing conspicuously the exits from such room. The word "Exit" shall be in letters at least six inches high over the opening to every means of egress from any such room, and in any such room having a greater seating capacity than four hundred, a red light furnished by gas or sperm oil shall be kept burning over such word during the entire period such room is open to the public and until the audience has left such room.

Sec. 317. (All Parts of Room Well Lighted During Performance.)—Every portion of any room used for the purposes of Class IV. and all outlets therefrom leading to the streets, including the passageways, courts and corridors, stairways, exits and emergency exit stairways, shall be well and properly lighted during every performance, and the same shall be kept so lighted until the entire audience has left the premises; and every passageway, or court, or corridor, or stairway, or exit, or emergency exit stairway, shall be provided with signs, indicating the way out of the building, the letters of which shall not be less than six inches in height.

Sec. 318. (Lights in Halls, Corridors and Lobbies, Control of.—Separate Shut-Off.—Connection with Gas Mains.—Protection of Suspended and Bracket Lights.—Protection of Lights Inserted in Walls.—Protection of Foot Lights.—Construction of Border Lights.—Ducts and Shafts Conducting Heated Air from Lights.—Protection of Stage Lights.)—All gas or electric lights in the halls, passageways, corridors, lobby or other means of ingress to or egress from any such room shall be controlled by a separate shut-off, located in the lobby, and controlled only in that particular place. Gas mains supplying any such room shall have independent connections for the auditorium and stage, and provision shall be made for shutting off the gas from the outside of the building. All suspended or bracket lights surrounded by glass, in the auditorium, or in any part of any such room, shall be provided with proper wire netting underneath. No gas or electric light shall be inserted in the walls, woodwork, ceilings, or in any part of any such room, unless protected by fireproof materials. The footlights, if gas light, in addition to the wire network, shall be protected by a strong wire guard, not less than two feet distant from such footlights, and the trough containing such footlights shall be formed of, and be surrounded by, fireproof materials. All border lights shall be constructed according to the best known methods, subject to the approval of the City Electrician, and shall be suspended by wire rope. All ducts and shafts used for conducting heated air from the main chandelier, or from any other light or lights, shall be constructed of metal, and made double, with an air space between. All stage lights, if gas, shall have strong metal wire guards or screens, not less than ten inches in diameter, so constructed that any material coming in contact therewith shall be out of reach of the flame, and such guards or screens shall be firmly soldered to the fixtures in all cases.

The use of calcium lights in any hall or room used regularly for theatrical or vaudeville performances is prohibited, and no calcium lights shall be permitted upon any stage; all arc lights used on the stage shall be subject to the approval of the City Electrician.

Sec. 319. (Apparatus Under Control of Fire Marshal.)—The standpipes, hose, and all apparatus for the extinguishing of fire or guarding against the same, required by the provisions of this Chapter to be provided, shall be at all times so provided and kept in a manner satisfactory to the Fire Marshal.

Sec. 320. (Scenery to Be Incombustible.)—No scenery or stage paraphernalia of any sort shall be used upon the stage of any room used for the purposes of class IV., unless such scenery and paraphernalia shall have been treated with a paint or chemical solution which shall make it non-inflammable, and which treated scenery or stage paraphernalia, or both, shall be tested and approved by the Fire Marshal.

Sec. 321. (Commissioner of Buildings, City Electrician, Fire Marshal and Superintendent of Police Empowered to Enter.)—The Commissioner of Buildings, City Electrician, Fire Marshal, Superintendent of Police, and their respective assistants, shall have the right to enter any building used wholly or in part for the purposes of Class IV. and any and all parts thereof, at any reasonable time, and at any time when occupied by the public, in order to examine such building, and it shall be unlawful for any person to interfere with them in the performance of their duties.

Sec. 322. (Power of Officers to Close.)—The Commissioner of Buildings, Fire Marshal, City Electrician or Superintendent of Police, or any one of them, shall have the power, and it shall be their joint and several duty, to order any building used wholly or in part for the purposes of Class IV. closed, where it is discovered that there is any violation of any of the provisions of this article, until the same are complied with.

Sec. 323. (License.—Mayor Shall Revoke.)—Upon the report to the Mayor by the Commissioner of Buildings, Fire Marshal, City Electrician, or Superintendent of Police, or any of them, that any order or requirement of this article in regard to buildings used wholly or in part for the purposes of Class IV. has been violated or is not being complied with, in any such building, the Mayor shall revoke the amusement license of any amusement or entertainment therein conducted, and shall cause such building, or portion thereof, devoted to the uses of Class IV., to be closed.

ARTICLE VIII.

PROVISIONS RELATING SOLELY TO CLASS V.

Buildings of Class V. Now in Existence.

In Class V. shall be included every building which is used as a public theatre where an admission fee is charged and in which movable scenery is used; provided, however, that public halls and club halls, with a seating capacity of less than six hundred, although occasionally used for theatrical representations, shall not be construed to be public theatres within the meaning of the term as used in this section, notwithstanding the fact that movable scenery is used upon the stage thereof on such occasions, and such public halls and club halls shall not be considered as buildings of Class V. as herein defined. Such public halls and club halls shall be included in Class IV., as defined in Section 400 of this ordinance.

Sec. 324. The following provisions shall apply to buildings now in existence and used wholly or in part for the purposes of Class V.

Sec. 325. (Walls.—Outside.—Structures Built Above.)—The outside walls of all such buildings, the roofs or ceilings of which are carried on trusses or girders of a span of fifty feet or more, shall be as follows:

If such walls are less than twenty-five feet high, they shall be not less than twenty inches thick.

If they are more than twenty-five feet and less than forty-five feet high, they shall be not less than twenty-four inches thick.

If they are more than forty-five feet and less than sixty feet high, they shall be not less than twenty-eight inches thick.

If they are more than sixty feet and less than seventy-five feet high, they shall be not less than thirty-two inches thick.

If they are more than seventy-five feet and less than ninety feet high, they shall be not less than thirty-six inches thick.

An increase of four inches in thickness of such walls shall be made in all cases where they are over one hundred feet long, without cross-walls of equal height.

The thickness of the walls enclosing or surrounding rooms used for the purposes of Class V., where such rooms are less than fifty feet wide, may be reduced by four inches.

If one or more stories are built above any room devoted to the uses of Class V., and such stories are carried on trusses or girders, the thickness of walls shall be increased by four inches for each two stories or part thereof above such room.

If solid masonry buttresses are employed and placed eighteen feet or less apart, and extended to the foot of the trusses or girders carrying the ceiling, or if iron or steel columns are inserted in such walls for the support of the superstructure, and at a distance not more than twenty-four feet between centers, and if such columns extend to and carry the superimposed trusses and girders, the thickness of such walls may be reduced in proportion to the increase of strength afforded by such buttresses or columns, but in no case shall any such wall be less than twelve inches thick in the top story, and four inches shall be added, going downward, for each story, for each gallery, or for each twenty-five feet in height of wall. Provided, that if in any such building now in existence the structural parts thereof do not comply with the foregoing requirements and structural changes are made therein, then all walls, columns or other structural parts shall be strengthened in a manner satisfactory to the Commissioner of Buildings.

Sec. 326. (Columns in Walls.—Alterations.)—If iron or steel columns are introduced in such walls, the brick work around the same shall be bonded into that of the connecting walls, and each of such columns shall be fireproofed as provided in Section 511 of this chapter. All alterations in such existing buildings intended to make them comply with the requirements of this chapter may be executed with the same kind of materials as those originally used in the construction of such buildings, unless otherwise provided by this chapter.

Sec. 327. (Other Classes Built in Conjunction with Class V.—Doors for Openings Between Connecting Buildings.)—In all cases where existing buildings used wholly or in part for the purposes of Class V. are built in conjunction with or as part of buildings devoted to the uses of other classes, and where such buildings of the other classes, as specified in this chapter, are not built entirely of fireproof construction, double iron doors shall be placed at each connecting opening between such buildings of Class V., and the building connected therewith.

Sec. 328. (Floor Levels.—Limitations of.)—The audience room or rooms or auditorium or auditoriums used for the purposes of Class V., containing in the aggregate not more than five hundred seats, if in a fireproof building, may be located in any story thereof, but in such case there shall be at least two separate stairways from the floor or floors in which such audience room or auditorium is located to the ground, each of which stairways shall be not less than four feet in width in the clear.

In existing buildings of fireproof construction, having an audience room or an auditorium with a seating capacity of more than five hundred and less than fifteen hundred, the lowest bank of seats of the main floor thereof shall be not more than twelve feet above the street level, and every such building shall in all other respects conform to the requirements of this chapter. The main floor of no existing theatre of any construction other than fireproof shall be raised above its present elevation.

Sec. 329. (Loads.—Allowance for Live Loads in Construction of Floors of Class V.)—For all buildings of Class V., all floors shall be designed and constructed in such manner as to be capable of bearing in all their parts, in addition to the weight of floor construction partitions and permanent fixtures and mechanisms that may be set upon the same, a live load of one hundred pounds for every square foot of surface in such floors.

Sec. 330. (Stairways.—Entrance and Exits.)—Stairways affording ingress to or egress from any room or rooms used for the purposes of Class V. shall be in width equivalent to twenty inches for every one hundred of seating capacity of such room and for fractional parts of one hundred a proportionate part of twenty inches of width shall be added, but in no event shall any such stairway be less than four feet wide in the clear, except as hereinafter provided in this section.

All such stairways shall have hand railings on each side thereof and shall not ascend a greater height than thirteen feet six inches without a level landing, and the length and width of such landing shall not be less than the width of the stairs; no run of stairs shall consist of less than six risers between platforms, and risers shall not be placed on return platforms. Stairways which are over 7 feet wide shall have double intermediate handrails, with end newel posts at least 5½ feet high.

Steps shall not have a greater rise than seven and three-eighths inches, treads shall not be narrower than eleven inches, and winders shall not be used on any staircase, except where circular staircases are expressly permitted.

In existing theaters each and every balcony and gallery shall have separate and distinct entrance stairways from the sidewalk level, except that in cases where the vestibule or entrance to any such theater is not more than fifteen inches, or two steps, above the sidewalk level and such steps are at or near the building line, the stairways to such balcony and gallery may ascend from the floor of such vestibule or entrance, but if the run of the stairs at the bottom is not toward the street, there shall be a hand rail or rails three feet above the floor constructed from the foot of such stairways for a distance of not less than five feet leading toward the street. All doors intervening between such stairways and the street shall, during each and every performance, be kept unfastened.

There shall be an iron stairway or stairways from the stage to the fly galleries and gridiron, continuing to the roof of the building or to some fireproof passageway or exit. Such stairways may be circular. Such circular stairways, however, shall not be used for access to the dressing rooms.

Stairs leading to a box or boxes seating not to exceed thirty people, in the aggregate, shall be independent of all other stairs and seats and not less than two feet eight inches wide in the clear. For each additional twenty-five of seating capacity, or major portion thereof, there shall be an additional width of five inches added to such stairways.

All stairways on the stage side of the proscenium wall shall be not less than two feet six inches wide.

Instead of increasing the width required for entrances, aisles, exits and stairways to that required by this chapter, the owner, lessee or manager of any such theater shall have the privilege of reducing the number of permanent seats therein until the same ratio between such width and number of seats as hereinbefore provided for shall be established, and if such privilege be taken advantage of, it shall be the

duty of the Commissioner of Buildings to make inspection and certify that such ratio actually exists before a license for the operation of any such theater shall be issued.

Sec. 331. (Floors at Exits.)—Floors at all exits shall be so designed as to be level and flush with adjacent floors and shall extend for an unbroken width of not less than four feet in front of each exit, and shall be two feet wider than such exit.

Sec. 332. (Seats in Rows Between Aisles.)—More than ten seats in any row between aisles in any gallery shall not be permitted. On the main floor and balcony, not more than eleven seats between aisles shall be permitted; provided, however, that in banks of seats on main floors and balconies that are not at a greater distance than twenty feet from an exit, thirteen seats shall be permitted between aisles.

Seats shall be not less than twenty inches in width, measured at the top of the seat backs.

Rows of seats shall be not less than two feet eight inches from back to back.

No bank of seats shall be of greater rise than twenty-two inches.

All groups of seats shall be so arranged that there shall be an aisle at each side of each group, provided, however, that groups of five seats or less may abut upon a tunnel at one side and an aisle at the other side.

The number of banks of seats on the main floor shall not exceed fifteen, unless an intervening or cross aisle is provided between each fifteen banks of seats or a direct exit is provided for each aisle.

The number of banks of seats in the balcony shall not exceed nine unless an intervening or cross aisle is provided between each nine banks of seats or a direct exit is provided for each aisle.

Sec. 333. (Tunnels.—Cross Aisles.—Vertical Rise.—Foyer.)—There shall be no more than twelve feet rise, measured vertically, in any aisle in any gallery without a direct exit by tunnel or otherwise to a corridor with free opening on to the gallery stairs or other direct discharge to the street, or at such elevation of twelve feet an intervening or cross aisle leading directly to an exit. No tunnel shall be less than three feet wide in the clear. No foyer shall be open to the theatre proper except through the exits.

Sec. 334. (Main Floor.—Balcony and Gallery.—Designation of.)—The lower floor of all theaters shall be designated the "Main Floor."

Where there are balconies or galleries, the first balcony or gallery shall be designated the "Balcony" and the second and third balcony or gallery shall be designated, respectively, "Gallery" and "Second Gallery." Such designation shall be printed plainly on all admission tickets.

Sec. 335. (Aisles, Corridors and Passageways.—Kept Unobstructed.—Steps in Aisles.)—The minimum width of aisles with diverging sides in any room or auditorium used for the purposes of Class V. shall be two feet eight inches at the end near the stage and not less than three feet at the other end.

The minimum width of aisles with parallel sides shall be three feet.

Every aisle shall lead as nearly as possible directly to an exit, but in no case shall the center line of such exit be more than three feet from the center line of any such aisle leading thereto. Steps shall not be permitted in aisles except as extending from bank to bank of seats and no riser shall be greater than seven and three-eighths inches, and no tread shall be less than nine and one-half inches, and whenever the rise from bank to bank of seats is less than five inches, the floor of the aisles shall be made as an inclined plane, and where steps are placed in outside aisles or corridors they shall not be isolated, but shall be grouped together and a light shall be maintained so that every place where there are steps in inclosing aisles or corridors shall be clearly lighted. All aisles, passageways, corridors and exits shall be kept free from camp stools, chairs, sofas and other obstructions, and no person shall be allowed to stand in or occupy any such aisles, passageways, corridors or exits during any performance, service, exhibition, lecture, concert or any public assemblage.

Sec. 336. (Corridors, Passageways, Hallways and Doors.—Width Of.)—The width of corridors, passageways, hallways and doors shall be computed in the same manner as that hereinbefore provided for stairways, excepting, however, that no corridor shall be anywhere less than four feet in width, and no door less than three feet wide, except as otherwise herein provided.

All corridors, passageways, hallways and stairways leading from any balcony or gallery to any toilet room, retiring room, smoking room, check room or private office, shall permit of free passage, without returning to an outer exit of the building. Such corridors, passageways, hallways and stairways shall be at least three feet in width in every part between such balcony or gallery and such outer exit, and shall be unobstructed in every part except by doors, not less than three feet in width in the clear, which shall swing outward and which shall not be provided with locks or catches of any kind whatever.

Sec. 337. (Doors.—Entrance.)—The entrance doors to every theater shall be of sufficient width to accommodate the entire audience, computed on the basis of twenty inches in width in the clear to each hundred permanent seats, and in addition thereto a proportionate part of twenty inches for a fractional part of each one hundred seats in the audience room or auditorium.

No mirrors shall be so arranged as to give the appearance of a doorway, exit, hallway or corridor, when no such doorway, exit, hallway or corridor is really in existence, nor shall there be any false doors or windows giving the appearance of an opening where none really exists.

Walls.—Ledges.—See Section 588.

Doors and Windows.—When Required to be Closed.—Fire-resisting Glass.—See Section 632.

Sec. 338. (Emergency Exits.—Width.—Emergency Stairs.—Width.—Emergency Exits Inside Walls of Buildings.—Fire Escapes, Construction.—Fire Escapes Leading to Street or Alley.—Doors Open Outward.)—Emergency exits and stairways shall be provided separately for each floor, balcony and gallery. They shall be of the same aggregate width as that provided for the main exits, and no emergency exit, doorway or stairway shall be less than three feet in width. Such emergency stairways shall be made of iron, steel or other incombustible materials. Such emergency exits shall be kept free of obstructions of any kind, including snow and ice.

Such emergency exits and stairways may be built inside the walls of the building, provided they are surrounded by a fireproof partition not less than four inches thick separating the exits and stairways from the audience room or auditorium.

If said emergency exits lead outside the building, the opening leading thereto shall have metal frames filled with wire glass doors opening outward, hung from the inside corner of the jambs, and so constructed as not to project, when opened, beyond the outside face of the wall. Outside shutters will not be permitted, except when the same shall open automatically from the interior, without resistance, and when used or opened will automatically fasten, securely, flat against the wall, so as not to in any way obstruct the passage on the outside; all such automatic devices or attachments to said doors to be subject to the approval of the Commissioner of Buildings and the Fire Marshal of the City of Chicago.

As amended October 22, 1906.

Whenever any such emergency stairway passes over an exit door or window or other opening, such stairway shall be completely inclosed for a space of five feet greater in width than such opening by iron, steel or other incombustible material.

All such emergency exits and stairways shall land at the ground level in a public thoroughfare or in some space that connects directly with a street or alley and direct and immediate exit to such public thoroughfare shall not be obstructed by any doors, gates, bars or other obstruction of any character.

Every court in which there is an emergency stairway shall have direct and unobstructed access along the surface of the ground to a street, alley or yard opening into an alley or street, without entering into or passing through or over any building unless by a four-foot wide fireproof passage on the court or ground level.

All doors in openings from any and all exits and stairways shall be so constructed that when opened they shall not obstruct any portion of any other doorway, opening or passageway.

All doors affording ingress to or egress from any theater shall open outward upon suitable hinges.

Sec. 339. (Exit Doors.—Particulars as to.)—Exit doors shall not be obscured by draperies and shall not be locked or fastened in any manner during the entire time such theater is open to the public, so as to prevent them from being easily opened outwardly; and such door shall be so constructed and maintained as to require no special knowledge or effort to open them from the interior.

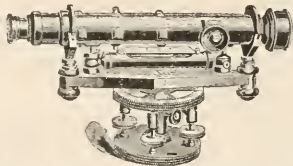
Sec. 340. (Wall.—Brick Proscenium Wall Between Auditorium and Stage.—Steel Curtain Fireproofed on Stage Side.—No Combustible Material on Audience Side.—Plans for Curtain.—Permit from Building Department.—Inspection.—Fee.)—There shall be in every theater a solid brick wall of the same construction and thickness as is required in outside walls between the auditorium and the stage. The main proscenium opening shall have a substantial steel curtain vertically operated and fireproofed on the stage side, which shall be raised and lowered by mechanical power and which shall be in constant use as the regular curtain and act drop.

No combustible material other than painted decorations shall be applied to the audience side of such curtains.

Plans for such curtain shall be approved by the building department and a permit obtained for its erection. The building department shall inspect such curtain semi-annually, for which inspection a fee of two (2) dollars shall be charged.

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All other openings in such proscenium wall shall have iron doors, frames and thresholds.

Sec. 341. (Stage, Construction Of.—Fireproof Paint.—Scenery.—How Treated.)—The framing of the floor of every stage shall be of iron or steel. The stage floor may be of wood, but shall not be less than two and three-fourths inches thick. The entire floor construction and floor of fly galleries, rigging lofts and paint gallery, all railings and supports and stanchions thereon, and all sheaves, pulleys and cables and their supports shall be of iron or steel. All woodwork, including the under side of floor boards, and all framing for scenery used on or about the stage shall be coated with a fireproof paint, the qualities of which shall be submitted to and approved by the Commissioner of Buildings. All wood used for floor and floor supports shall be coated on the under side with the same kind of paint.

No scenery or stage paraphernalia of any sort shall be used upon the stage of any room used for the purposes of Class V., unless such scenery and paraphernalia shall have been treated with a paint or chemical solution which shall make it non-inflammable, and which treated scenery or stage paraphernalia, or both, shall be tested and approved by the Fire Marshal.

Sec. 342. (Vestibule of Stage Doors.)—All doorways or openings in the rear or sides of the stage shall be vestibuled or protected in a manner satisfactory to the Commissioner of Buildings, so as to protect the curtain, scenery and auditorium against draughts of air.

Sec. 343. (Vents, Flue Pipes, Size of.—Dampers.—Switches for Dampers.)—One or more vents or flue pipes, of metal construction, or other incombustible material suitable for carrying away smoke, approved by the Commissioner of Buildings, and extending not less than fifteen feet above the highest point of the roof, and equivalent in area to one-twentieth of the area of the stage, shall be built over the stage.

In buildings where additional stories are built above the stage, such vents or flue pipes may be carried out near the top of the stage walls and shall be continued and run up on the exterior of the building to a point five feet above the highest point of such additional stories.

All such flues or vents shall be provided with metal dampers, and shall be opened by a closed circuit battery approved by the city electrician; such dampers shall be controlled by two switches, one at the electrician's station on the stage, which station shall be fireproof, and the other at the city fireman's station on the opposite side of the stage; such switches shall be located at such places on the stage as are designated by the fire marshal, and each shall have a sign with plain directions as to the operation of same printed thereon.

All fuse boxes shall be surrounded by two thicknesses of fireproof material, with an air space between, and no fuses shall be exposed to the air between the switch-boards.

Sec. 344. (Automatic Sprinklers.—Location Of.—Tank.—Connections.)—There shall be provided an approved system of automatic sprinklers, with approved automatic closed circuit electric devices connecting the valves regulating the flow of water in the various sprinkler pipes, with the headquarters of the city fire alarm telegraph and such other place or places as the Fire Marshal shall direct, so arranged as to prevent any tampering with the system or the shutting off of the water from the sprinkler pipes without automatic notice to the fire department.

Such system of automatic sprinklers shall be supplied with water from a tank located not less than twenty feet above the level of the highest sprinkler head in the system, and it shall be the duty of the fireman provided for in this chapter to include in his daily report the result of an inspection to determine the sufficiency of water in this tank. Automatic sprinklers shall be placed in the paint room, store-room, property room, scene storage room, carpenter shop and dressing rooms, if such rooms are in or connected with a building used for the purposes of Class V., such tank shall not be connected with a standpipe and ladder system, but shall be filled through a separate pipe from a fire pump, and a three-inch iron pipe shall extend from such tank to the outside of such building, with Siamese connections for fire department use. Such entire automatic sprinkler system and equipment and the location thereof shall be subject to the approval of the Fire Marshal.

Sec. 345. (Fire Apparatus on Stage.—Hand Fire Pumps.—Fire Materials.—Hot Air Furnaces.)—A standpipe not less than two and one-half inches in diameter, having a hose valve or valves thereon, shall be installed on each side of the stage, with a hose connection at the stage and at each level above and below the stage, and hose connected thereto at each valve ready for use at all times. Such standpipe shall be connected with a tank on the roof containing not less than three thousand gallons of water, protected from frost, and also with a power pump, all of which shall be

subject to the approval of the Fire Marshal. Portable fire extinguishers or hand fire pumps shall always be kept ready for use on and under the stage; in fly galleries and in rigging lofts, and in addition thereto at least four fire department axes and six pike poles shall be kept ready for use on each tier or floor of the stage, all of which shall be subject to the approval of the Fire Marshal.

The use of ordinary hot air furnaces or stoves is prohibited.

Sec. 346. (**Exits.—Diagram Of, Printed on Program.**)—It shall be the duty of the owner, lessee or manager of any theater, for any performance in which programs are issued, to cause to be printed on such programs, on the page opposite that upon which the cast is printed, a diagram showing conspicuously all exits of such building. A diagram of seats of each floor, and the exits leading from each floor drawn to a scale of one-eighth inch to the foot, shall be hung in a frame within two feet of the ticket seller's window and so as to be easily seen by the public.

Sec. 347. (**Lighting.—Independent Lighting System for Exits.—Red Light Over Exits.**)—All stairways and corridors shall be supplied with a supplementary lighting system of electricity, gas or sperm oil, and such system shall be independent of all other lights in such building and shall be in operation during the entire period such theater is open to the public and until the audience has left the building. The word "EXIT" shall be in letters at least six inches high over the opening to every means of egress from such theater and a red light furnished by gas or sperm oil shall be kept burning over such word "EXIT" at every such opening, during the entire period such theater is open to the public and until the audience has left the building.

Sec. 348. (**Fire Alarm Apparatus.**)—Every theater shall be provided with an approved system of automatic or manual fire alarm telegraph apparatus, connected by the necessary wires with the headquarters of the city fire alarm telegraph, and such other place or places as the Fire Marshal may direct. The number and location of the boxes and the character of the system, whether automatic or manual, or both, shall be determined by the Fire Marshal.

Sec. 349. (**Fireman.—Employment Of—Duties.**)—It shall be the duty of every person or corporation conducting, maintaining or operating a theater, to employ one competent, experienced fireman, who shall be detailed by the Fire Marshal from the regular City Fire Department; such fireman shall be in the uniform of the Chicago Fire Department, and he shall be on duty at such theater during the whole time it is open to the public; he shall report to and be subject to the orders of the Fire Marshal; and shall see that all fire apparatus required by this chapter is in its proper condition, ready for use and that all exit doors are unlocked during the whole time such theater is open to the public and are all in efficient and ready working order.

The compensation to be paid the city for the services of such city fireman so detailed and employed shall be based on the regular salary paid by the city to such fireman, and shall be computed according to the ratio between the number of hours such fireman is employed at such theater and the total number of hours such fireman is employed by the city for all purposes.

It shall also be the duty of every person or corporation conducting, maintaining or operating a theater, to employ, in addition to the fireman employed by such persons and detailed by the Fire Marshal, one other experienced and competent person as a private watchman or fireman, who shall be approved by the Fire Marshal; and who shall be in distinctive uniform; and shall be on duty at such theater during the whole time it is open to the public; such private watchman or fireman shall report and be subject to the orders of the Fire Marshal, and it shall be his duty to see that the provisions of this chapter are complied with in all portions of the theater occupied and used by the public; and that all exit doors are unlocked during the whole time such theater is open to the public and in efficient and ready working order. The city fireman and Fire Marshal shall require a drill of the employees of such theater, including such private watchman or fireman, in the use of all apparatus and appliances for the prevention of fire inside the building and the saving of life, at least twice in every week, and such city fireman shall report to the Fire Marshal the manner and efficiency of such drill. Such city fireman shall report in writing, daily, to the Fire Marshal the condition and equipment of the theater to which he is detailed. No city fireman shall be on duty at any one theater for a longer period than two (2) weeks.

Sec. 350. (**Amusement License.**)—The amusement license issued for each theater shall state the number of permanent seats the theater contains, which number shall be governed by the provisions of this ordinance relating thereto, and no more than that number of persons shall be permitted to be in such theater at any one time.

No license for the operation of a theater will be issued unless the Commissioner of Buildings, Fire Marshal and the City Electrician shall first have certified, in writing, that such theater complies with the provisions of this chapter in every respect.

Sec. 351. (Lighting.—All Parts Well Lighted During Performances.)—Every portion of any theater devoted to the use or accommodation of the public and all outlets therefrom leading to the streets, including all open courts, corridors, stairways, exits and emergency exit stairways, shall be well and properly lighted during every performance, and the same shall remain lighted until the entire audience has left the premises.

Sec. 352. (Lights.—Control of Lights in Halls, Corridors and Lobbies.—Separate Shut-off.—Connections with Gas Mains.—Independent Connections.—Protection of Suspended and Bracket Lights.—Protection of Lights Inserted in Walls.—Protection of Footlights.—Construction of Border Lights.—Ducts and Shafts Conducting Heated Air from Lights.—Gas Stage Lights to Have Metal Screens.)—All gas or electric lights in the halls, corridors, lobbies or any part of any theater used by the audience, except the auditorium, shall be controlled by a separate shut-off, located in the lobby, and controlled only in that particular place. Gas mains supplying such theater shall have independent connections for the auditorium and the stage, and provision shall be made for shutting off the gas from the outside of the building. All suspended or bracket lights surrounded by glass in the auditorium, or in any other part of the theater, shall be provided with proper wire netting underneath. No gas or electric lights shall be inserted in the walls, woodwork, ceilings, or in any part of the theater, unless protected by fireproof materials. In case gas is used the footlights, in addition to the wire network, shall be protected by a strong wire guard not less than two feet distant from such footlights, and the trough containing such footlights shall be formed of and surrounded by fireproof material. All border lights shall be constructed according to the best known method, and subject to the approval of the Fire Marshal and the City Electrician, and shall be suspended by wire rope. All ducts and shafts used for conducting heated air from the main chandelier, or from any other light or lights, shall be constructed of metal and made double, with an air space between. All gas stage lights shall have strong metal wire guards or screens not less than ten inches in diameter, so constructed that any material coming in contact therewith shall be out of reach of the flames of such lights, and such guards or screens shall be soldered to the fixtures in all cases.

The use of calcium lights in any theater is prohibited. All arc lights used on the stage shall at all times be subject to the approval of the city electrician, and no arc lights shall be used on any stage unless approved by said city electrician.

Sec. 353. (Fire Apparatus.—Under Control of Fire Department.)—The stand-pipes, automatic sprinklers, gas pipes, electric wires, hose, footlights, fire alarm boxes, fireproof proscenium curtain, switch boxes, ventilators, controlling levers, axes and pike poles, and all apparatus for the extinguishing of fire or guarding against the same, as provided for by this chapter, shall be made and kept at all times in condition satisfactory to and under the control of the Fire Marshal.

Sec. 354. (Officers Empowered to Enter Buildings.)—The Commissioner of Buildings, Fire Marshal, City Electrician, Superintendent of Police, or any of them, and their respective assistants, shall have the right to enter any building used wholly or in part for the purposes of Class V., and any and all parts thereof, at any reasonable time, and at any time when occupied by the public, in order to examine such buildings; to judge of the condition of the same and to discharge their respective duties, and it shall be unlawful for any person to interfere with them, or any of them, in the performance of their duties.

Sec. 355. (The Commissioner of Buildings, Fire Marshal, City Electrician or Superintendent of Police Shall Close Buildings for Violations.)—The Commissioner of Buildings, Fire Marshal, City Electrician and the Superintendent of Police, or any one of them, shall have the power and it shall be their joint and several duty, to order any building used wholly or in part for the purposes of Class V., closed, where it is discovered that there is any violation of any of the provisions of this chapter and keep same closed until such provisions are complied with.

Sec. 356. (License.—Mayor Shall Revoke.)—Upon a report to the Mayor by the Commissioner of Buildings, Fire Marshal, City Electrician or the Superintendent of Police that any requirement of this chapter, or that any order given by them or any of them in regard thereto has been violated, or not complied with, the Mayor shall revoke the license of any such theater or place of amusement so reported and cause the same to be closed.

Buildings of Class V. Hereafter Erected.

Sec. 357. The following provisions shall apply to buildings hereafter erected and used wholly or in part for the purposes of Class V.

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Sec. 358. (**Walls.—Outside Walls.—Structures Built Above.**)—The outside walls of all such buildings, the roofs or ceilings of which are carried on trusses or girders of a span of fifty feet or more, shall be as follows:

If such walls are less than twenty-five feet high they shall not be less than twenty inches thick.

If they are more than twenty-five feet and less than forty-five feet high they shall be not less than twenty-four inches thick.

If they are more than forty-five feet and less than sixty feet high they shall be not less than twenty-eight inches thick.

If they are more than sixty feet and less than seventy-five feet high they shall be not less than thirty-two inches thick.

If they are more than seventy-five feet and less than ninety feet high, they shall be not less than thirty-six inches thick.

An increase of four inches in thickness of such walls shall be made in all cases where they are over one hundred feet long without cross walls of equal height.

The thickness of the enclosing or surrounding walls of rooms used for the purposes of Class V., where such rooms are less than fifty feet wide, may be reduced by four inches.

If one or more stories are built above any room devoted to the uses of Class V., and such stories are carried on trusses or girders, the thickness of walls shall be increased by four inches for each two stories or part thereof above such room.

If solid masonry buttresses are employed and placed eighteen feet or less apart, and extended to the foot of the trusses or girders carrying the ceiling, or if iron or steel columns are inserted in such walls for the support of the superstructure, and at distances not more than twenty-four feet between centers, and if such columns extend to and carry the superimposed trusses or girders, the thickness of such walls may be reduced in proportion to the increase of strength afforded by such buttresses or columns, but in no case shall any such wall be less than twelve inches thick in the top story, and four inches shall be added, going downward, for each story, for each gallery, or for each twenty-five feet in height of wall.

Sec. 359. (**Columns in Walls.**)—If iron or steel columns are introduced in such walls, the brickwork around such columns shall be bonded into the brickwork of the connecting wall, and each of such columns shall be fireproofed, as provided in Section 511 of this chapter.

Walls Around Stairs, Elevators and Shafts.—See Section 588.

Sec. 360. (**Construction.—Frontage.—Open Spaces and Enclosed Passages.**)—All buildings hereafter erected and used wholly or in part for the purposes of Class V. shall be built entirely of fireproof construction and shall be located so that they adjoin at least two public thoroughfares, one of which shall be a public street, and the other may be a public alley not less than ten (10) feet in width.

All floors, balconies and galleries of the audience room of every theater shall have open spaces or fireproof passageways on the three sides other than the proscenium; and on each of the two opposite sides other than the back and proscenium of every stage there shall be open spaces or fireproof passageways, and such open spaces or fireproof passageways shall open on or connect directly with the public thoroughfares.

All open spaces shall not be less than ten (10) feet in width and all fireproof passageways shall not be less than eight (8) feet in width, and shall be outside of the audience room, and shall be kept and maintained free and clear of obstructions of any and all kinds at any and all times.

All open spaces shall be open and unobstructed from the floor or pavement of such space to the sky, with the exception that emergency stairs and emergency balconies may be built in such open spaces. The entire floor of every open space shall be level or inclined; the incline shall not exceed two (2) inches in height for each one foot of horizontal measurement.

If one or more fireproof passageways are required on one side of the stage, then the fireproof passageways of each floor and the balcony and each gallery of the audience room shall be continued through the stage house as fireproof passageways to an open space or public thoroughfare, and from the end of each such fireproof passageway there shall be doors or stairs, or both, which shall be arranged so as to afford a safe exit for the audience of such theater to the pavement of the public thoroughfares, and if fireproof passageways are required on both sides of the stage, then they shall be arranged and connected with all of the fireproof passageways on both sides of the audience room in the same manner as described for fireproof passageways when these are required only on one side of the stage.

The fireproof passageways for the main floor may pass under the stage floor.

Provided, however, that where there is no public thoroughfare or open space at the back of the stage and on one side of the stage, then the fireproof passageways

for the main floor shall be on the stage floor and shall be built along that side of the stage on which there is no public thoroughfare and across the back of the stage to one of the public thoroughfares, and the fireproof passageways for the balcony and the fireproof passageways for the galleries shall each be built along the side of the stage and across the back of the stage, in a continuation of the balcony and gallery floor level to a public thoroughfare.

The fireproof passageways of the different floors, of the balcony and of the galleries, shall be independent of each other and shall not be connected with each other in any manner.

No doors or other openings except entrance doors from the audience room or exit doors to a thoroughfare shall be in the walls of a fireproof passageway; and all such doors shall be so arranged that when open they shall not obstruct the passage.

The walls of a fireproof passageway shall be not less than four (4) inches thick, and each and every part of such passageway, including each and all of its supports, shall be built of fireproof construction as required in the general provisions relating to fireproof construction of this chapter.

Radiators for warming passageways shall be in recesses.

There shall be no steps or risers in a fireproof passageway, but where necessary inclined floors of the full width of the fireproof passageways may be built; the incline of the floor shall not exceed two and one-half ($2\frac{1}{2}$) inches in height per foot, measured horizontally, and no such incline shall be less than ten (10) feet in length. No fireproof passageway shall be less than eight (8) feet high in any part thereof, except at doors, and these shall not be less than seven (7) feet high.

If the principal entrance corridor of a theater is at one side of the audience room, then the center line extended of such principal entrance shall intersect the center axis of the stage and the audience room between the back of the seat most remote from the stage on said center axis of the stage and the audience room, and a point midway between such seat and the wall opposite the proscenium wall.

Sec. 361. (Buildings of Other Classes Built in Conjunction With Class V.—Construction of.)—If buildings used wholly or in part for purposes of Class V. are built in conjunction with or as part of buildings devoted to the uses of other classes, then such buildings of other classes shall be built entirely of fireproof construction.

Sec. 362. (Floor Levels.—Limitation Of.)—In all cases where the floors of the auditorium of any theater in any such building of Class V. are banked or stepped up, the floor level of the lowest bank shall not be above the sidewalk level.

All floors shall be designed and constructed in such manner as to be capable of bearing in all their parts, in addition to the weight of floor construction, permanent fixtures and mechanisms that may be set upon the same, a live load of one hundred pounds for every square foot of surface in such floors.

The audience room or rooms or auditorium or auditoriums used for the purposes of Class V. containing, in the aggregate, not more than five hundred seats, if in a fireproof building, may be located in any story thereof, but in such case there shall be at least two separate stairways from the floor or floors in which such audience room or auditorium is located to the ground, each of which stairways shall be not less than four feet in width in the clear.

Sec. 363. (Stairways.—Entrances and Exits.)—Stairways affording ingress to or egress from any room used for the purposes of Class V. shall be in width equivalent to twenty inches for every one hundred of seating capacity of such room, and for fractional parts of one hundred a proportionate part of twenty inches of width shall be added, but in no event shall any such stairway be less than four feet wide in the clear, except as hereinafter provided.

All such stairways shall have hand railings on each side thereof, and shall not ascend a greater height than thirteen feet six inches without a level landing, and the length and width of such landing shall be not less than the width of the stairs; no run of stairs shall consist of less than six risers between platforms, and risers shall not be placed on return platforms. Stairways which are over seven feet wide shall have double intermediate handrails with end newel posts at least five and a half feet high.

Steps shall not have a greater rise than seven and three-eighths inches, treads shall not be narrower than eleven inches, and winders shall not be used on any staircase.

Each and every balcony and gallery shall have separate and distinct entrances and stairways from the sidewalk level. The bottom run of the stairs shall be directly toward the street. Such stairs may ascend from the vestibule or entrance inside of

the building, but the bottom riser of such stairs shall be not more than sixty-five feet from the building line. All doors between such stairs and the street shall be kept unlocked and unfastened during each and every performance and until the audience has left the building.

There shall be an iron stairway or stairways from the stage to the fly gallery and gridiron, continuing to the roof of the building or to some fireproof passageway or exit. Such stairways may be circular. Such circular stairways, however, shall not be used for access to the dressing rooms.

Stairs leading to a box or boxes seating not to exceed thirty people in the aggregate shall be independent of all other stairs and seats, and not less than two feet eight inches wide in the clear. For each additional twenty-five of seating capacity or major portion thereof in such box or boxes there shall be an additional five inches in width of such stairway.

All stairways on the stage side of the proscenium wall shall be not less than two feet six inches wide.

Sec. 364. (Floors at Exits—Seating.)—Floors at all exits shall be so designed as to be level and flush with adjacent floors and shall extend for an unbroken width of not less than four feet in front of each exit, and shall be two feet wider than such exit.

More than ten seats in any one row between aisles shall not be lawful.

Seats shall be not less than twenty-two inches in width, measured at the top of the seat backs.

Rows of seats shall not be less than two feet ten inches from back to back.

No bank of seats shall have a greater rise than twenty-two inches.

All groups of seats shall be so arranged that there shall be an aisle at each side of each group, provided groups of five seats or less may abut upon a tunnel at one side and an aisle at the other side.

The number of banks of seats on the main floor shall not exceed fifteen, unless an intervening or cross aisle is provided between each fifteen banks of seats or a direct exit is provided for each aisle. The number of banks of seats in the "balcony" shall not exceed nine, unless an intervening or cross aisle is provided between each nine banks of seats or a direct exit is provided for each aisle.

Sec. 365. (Tunnels.—Cross Aisles.—Vertical Rise.—Foyer.)—There shall be no more than eleven feet rise, measured vertically, in any aisle in any gallery without a direct exit by tunnel or otherwise, to a corridor with free opening on to the gallery stairs or other direct discharge to the street, or at any such elevation of eleven feet an intervening or cross aisle leading directly to an exit. No tunnel shall be less than three feet wide in the clear.

No foyer shall be open to the theater proper except through the exits.

Sec. 366. (Main Floor.—Balcony and Gallery.—Designation Of.)—The lower floor shall be designated the "Main floor."

Where there are balconies or galleries the first balcony or gallery shall be designated the "Balcony," and the second and third balcony or gallery shall be designated, respectively, "Gallery" and "Second Gallery." Such designation shall be printed plainly on all admission tickets.

Sec. 367. (Aisles and Passageways.—Kept Unobstructed.—Steps in Aisles.)—The minimum width of aisles with diverging sides in any room or auditorium used for the purposes of Class V, shall be two feet eight inches at the end near the stage, and not less than three feet at the other end.

The minimum width of aisles with parallel sides shall be three feet.

Every aisle shall lead directly to an exit. Steps shall not be permitted in aisles except as extending from bank to bank of seats, and no riser shall be more than seven and three-eighths inches in height, and no tread shall be less than ten inches in width, and whenever the rise from bank to bank of seats is less than five inches, the floor of the aisles shall be made as an inclined plane; and where steps are placed in outside aisles or corridors they shall not be isolated, but shall be grouped together, and a light shall be maintained so that every place where there are steps in enclosing aisles or corridors shall be clearly lighted. All aisles, passageways, corridors and exits shall be kept free from camp stools, chairs, sofas and other obstructions, and no person shall be allowed to stand in or occupy any such aisles, passageways, corridors or exits during any performance, service, exhibition, lecture, concert or at any public assemblage.

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Sec. 368. (Corridors.—Passageways.—Hallways and Doors.—Width of Entrance Doors.)—The width of corridors, passageways, hallways and doors shall be computed in the same manner as that hereinbefore provided for stairways, excepting, however, that no corridors shall be anywhere less than four feet in width and no doorway less than three feet wide, except as otherwise herein provided.

All corridors, passageways, hallways and stairways leading from any balcony or gallery to any toilet room, retiring room, smoking room, cloak room, check room or private office shall permit of free passage, without returning, to an outer exit of the building. Such corridors, passageways, hallways and stairways shall be at least three feet in width in every part between such balcony or gallery and such outer exit, and shall be unobstructed in every part, except by doors not less than three feet in width in the clear, which shall swing outward and which shall not be provided with locks or catches of any kind whatever.

The entrance doors to every theater shall be of sufficient width to accommodate the entire audience, computed on the basis of twenty inches of width in the clear to each one hundred permanent seats or proportionate part thereof in the audience room or auditorium of such theater, and all doors shall be so arranged that when open they shall not obstruct any corridor or passage whatsoever into which they open.

No mirrors shall be so arranged as to give the appearance of a doorway, exit, hallway or corridor, when no such doorway, exit, hallway or corridor is really in existence, nor shall there be any false doors or windows giving the appearance of an opening where none really exists.

Sec. 369. (Emergency Exits, Width.—Emergency Stairs, Width.—Emergency Exits Inside Walls of Buildings.—Fire Escapes, Construction.—Fire Escapes Leading to Street or Alley.—Doors Open Outward.)—Emergency exits and stairways shall be provided separately for each floor, balcony or gallery. They shall be of the same size as that provided for the main exits, and no emergency exit, doorway or stairway shall be less than three feet in width. Such emergency stairway shall be made of iron, steel or other incombustible material. Such emergency exit shall be kept free of obstructions of any kind, including snow and ice.

Such emergency exits and stairways may be built inside the walls of the building, provided they are surrounded by a fireproof partition not less than four inches thick, separating the exits and stairways from the audience room or auditorium.

If such emergency exits lead outside the building, the openings leading thereto shall have metal door frames and metal doors with panels filled with fire-resisting glass, opening outward, hung from the inside corner of the jambs, and so constructed as not to project when opened beyond the outside face of the wall, and outer shutters shall not be permitted.

Whenever any such emergency stairway passes over an exit or door or window or other opening, such stairway shall be completely enclosed for a space of five feet greater in width than such opening, by iron, steel or other incombustible material.

All such emergency exits and stairways shall land at the ground level in a public thoroughfare or in some space that connects directly with a street or alley, and direct and immediate exit to such public thoroughfare shall not be obstructed by any door, gate, bars or other obstruction of any character.

Every court in which there is an emergency stairway shall have direct and unobstructed access along the surface of the ground to a street, alley or yard opening into an alley or street without entering into or passing through or over any building unless by a four-foot wide fireproof passage on the court or ground level.

All doors in openings from emergency exits and stairways shall be so constructed that when opened they will not obstruct any portion of any other doorway, opening or passageway.

All doors affording ingress to or egress from any theater shall open outward upon suitable hinges.

Exit doors shall not be obscured by draperies and shall not be locked or fastened in any manner during the entire time such theater is open to the public, so as to prevent them from being easily opened outwardly; and such doors shall be so constructed and maintained as to require no special knowledge or effort to open them from the interior.

Sec. 370. (Wall.—Brick.—Proscenium Between Auditorium and Stage.—Steel Curtain Fireproofed on Stage Side.—No Combustible Material on Audience Side.—Plans for Curtain.—Permit from Building Department.—Inspection Fee.)—There shall be a solid brick wall of the same construction and thickness as is required in the outside walls of the building in which such theater is located between the auditorium and the stage.

The main proscenium opening shall have a vertically operated steel curtain which shall, when it is lowered, completely close such proscenium opening. The curtain

shall be raised and lowered by mechanical power, other than hand power, as the regular curtain and act drop each and every time there is an audience in the theater.

The lowering of the curtain shall be controlled from not less than two points in the building, one of which shall be designated by the Commissioner of Buildings.

The curtain shall have a steel covering on the outer or auditorium side. The stage side covering shall be of a non-conducting substance of such a thickness and such material as shall stand a test of two thousand degrees F. on the stage side for fifteen minutes and without heating the opposite side to a higher temperature than three hundred and fifty degrees F.

All metal work with the exception of the frame shall be covered with a non-conducting substance on the stage side.

The curtain shall operate vertically in steel guides of such a cross section that the edges shall engage and secure the edges of the curtain and prevent the curtain from leaving the guiding channel or channels if the curtain should tend to buckle or bag either inward or outward. No metal in the guide channels or in the engaging edge of the curtain shall be less than three-eighths ($\frac{3}{8}$) of an inch thick. The joints of the curtain with the proscenium wall, with the stage floor and with the head of the opening shall be made gas tight as nearly as practicable.

The calculations for the strength of the curtain, the curtain guides and the guide anchors, and the workmanship shall be according to the best modern engineering practice, the stresses in the material and in the various sections of steel shall be within the safe limits of stress described in this ordinance.

No part of a curtain or of the curtain guides shall be supported by or fastened to any combustible material.

The supports of the curtain and the curtain guides and edges and the curtain shall be of sufficient strength to safely resist a pressure of twenty (20) pounds for each and every square foot of the curtain either inward or outward, if such curtain does or does not bag.

No combustible material other than painted decorations shall be applied to the audience side of any such curtain.

Plans for every such curtain shall be approved by the Building Department and a permit obtained for its erection. The Building Department shall inspect such curtain semi-annually, and for each such inspection a fee of two (2) dollars shall be charged.

All other openings in such proscenium wall shall have self-closing, regulation standard iron fire doors and iron frames and thresholds; such doors and frames shall be built in such a manner as to resist warping.

Sec. 371. (Stage, Construction of.—Fireproof Paint.—Scenery.—How Treated.)—The framing of the floor of every stage shall be of iron or steel or fireproof material. The stage floor may be of wood, but shall not be less than two and three-fourths inches thick. The entire floor construction and floor of fly galleries, rigging lofts and paint galleries, all railings and supports and stanchions thereon, and all sheaves, pulleys and cables and their supports shall be of iron or steel. All woodwork, including the under side of floor boards, and all framing for scenery used on or about the stage shall be coated with a fireproof paint, the qualities of which shall be submitted to and approved by the Commissioner of Buildings. All wood used for floor and floor supports shall be coated on the under side with the same kind of paint.

No scenery or stage paraphernalia of any sort shall be used upon the stage of any room used for the purposes of Class V., unless such scenery and paraphernalia shall have been treated with a paint or chemical solution which shall make it non-inflammable, and which treated scenery or stage paraphernalia, or both, shall be tested and approved by the Fire Marshal.

Sec. 372. (Vestibules for Stage Doors.)—All doorways or openings in the rear or sides of the stage shall be vestibuled or protected in a manner satisfactory to the Commissioner of Buildings, so as to protect the curtain, scenery and auditorium against draughts of air.

Sec. 373. (Structures Over Ceiling.—Construction.)—If any structure is built over the ceiling or roof of any theater, the different members of the girders or trusses supporting same shall have their fireproofing double, in the manner prescribed for columns of fireproof buildings as specified in the General Provisions of this chapter.

Sec. 374. (Vents.—Size Of.—Flue Pipes.—Dampers.—Switches for Dampers.)—One or more vents or flue pipes of metal construction, or other incombustible material, suitable for carrying away smoke, and approved by the Commissioner of Buildings, and extending not less than fifteen feet above the highest point of the roof,

and equivalent in area to one-twentieth of the area of the stage, shall be built over the stage.

In buildings where additional stories are built above the stage, such vents or flue pipes may be carried out near the top of the stage walls, and shall be continued and run up on the exterior of the building to a point five feet above the highest point of such additional story.

All such flues or vents shall be provided with metal dampers, and shall be opened by a closed circuit battery, approved by the City Electrician.

Such dampers shall be controlled by two switches, one at the electrician's station on the stage, which station shall be fireproof, and the other at the city fireman's station, on the opposite side of the stage; such switches shall be located in such places on the stage as are designated by the Fire Marshal, and each shall have a sign with plain directions as to the operation of the same printed thereon.

All fuse boxes shall be surrounded by two thicknesses of fireproof material, with an air space between, and no fuses shall be exposed to the air between the switchboards.

Sec. 375. (Automatic Sprinklers.—Location.—Tank.—Connections.)—There shall be provided an approved system of automatic sprinklers with approved automatic closed circuit electric devices connecting the valves, regulating the flow of water into the various sprinkler pipes with the headquarters of the city fire alarm telegraph, and such other place or places as the Fire Marshal shall direct, so arranged as to prevent any tampering with the system or the shutting off of the water from the sprinkler pipes without automatic notice to the fire department.

Such system of automatic sprinklers shall be supplied with water from a tank located not less than twenty feet above the level of the highest sprinkler head in the system, and it shall be the duty of the firemen provided for in this chapter to include in their daily report the result of an inspection to determine the sufficiency of water in this tank. Automatic sprinklers shall be placed in the paint room, store room, property room, scene storage room, carpenter shop and dressing rooms, if such rooms are in or connected with a building used for the purposes of Class V. Such tank shall not be connected with a standpipe and ladder system, but it shall be filled through a separate pipe from a fire pump, and a three-inch iron pipe shall extend from such tank to the outside of such building with Siamese connections for fire department use. Such entire automatic sprinkler system and equipment and the location thereof shall be subject to the approval of the Fire Marshal.

Sec. 376. (Fire Apparatus on Stage.—Hand Fire Pumps.—Fire Materials.—Hot Air Furnaces.)—A standpipe not less than three inches in diameter, having a hose valve or valves thereon shall be installed on each side of the stage with a hose connection at the stage and at each level above and below the stage, and hose connected thereto at each valve ready for use at all times. Such standpipes shall be connected with a tank on the roof containing not less than three thousand gallons of water, protected from frost, and such tank shall be connected with and supplied by a power pump, all of which shall be subject to the approval of the Fire Marshal. Portable fire extinguishers or hand fire pumps shall always be kept ready for use on and under the stage, in fly galleries and in rigging loft, and in addition thereto at least four fire department axes and six pike poles shall be kept ready for use on each tier or floor of the stage, all of which shall be subject to the approval of the Fire Marshal.

The use of ordinary hot air furnaces or stoves is prohibited.

Sec. 377. (Exits.—Diagram of.—Printed on Programs.)—It shall be the duty of the owner, lessee or manager of any theater, for any performance in which programs are issued, to cause to be printed on such programs on the page opposite that on which the cast is printed, a diagram showing conspicuously all exits of such building. A diagram of seats on each floor, and the exits leading from each floor, drawn to a scale of one-eighth inch to the foot, shall be hung in a frame within two feet of the ticket seller's window and so as to be easily seen by the public.

Sec. 378. (Independent Lighting System for Exits.—Red Light Over Exits.)—All stairways and corridors shall be supplied with a supplementary lighting system of electricity, gas or sperm oil, and such system shall be independent of all other lights in such building, and shall be in operation during the entire period such theater is open to the public and until the audience has left the building. The word "EXIT" shall be in letters at least six inches high over the opening to every means of egress from such theater and a red light, furnished by gas or sperm oil, shall be kept burning over such word "EXIT" at every such opening, during the entire period such theater is open to the public and until the audience has left the building.

Sec. 379. (Fire Alarm Apparatus.)—Every theater shall be provided with an approved system of automatic or manual fire alarm telegraph apparatus, connected by



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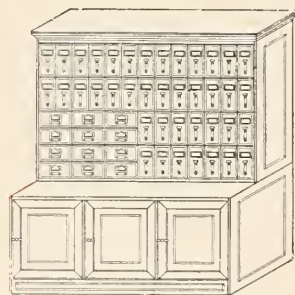
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the necessary wires with the headquarters of the city fire alarm telegraph and such other place or places as the Fire Marshal shall direct. The number and location of the boxes and the character of the system, whether automatic or manual or both, shall be determined by the Fire Marshal.

Sec. 380. (Firemen.—Employment of.—Duties of.)—It shall be the duty of every person, or corporation, conducting, maintaining or operating a theater, to employ one competent, experienced fireman, who shall be detailed by the Fire Marshal from the regular City Fire Department; shall be in the uniform of the Chicago Fire Department; shall be on duty at such theater during the whole time it is open to the public; shall report to and be subject to the orders of the Fire Marshal; shall see that all fire apparatus required by this chapter is in its proper condition, ready for use; all exit doors unlocked during the whole time such theater is open to the public, and all in efficient and ready working order.

The compensation to be paid the city for the services of such city fireman so detailed and employed shall be based upon the regular salary paid by the city to such fireman and shall be computed according to the ratio between the number of hours such fireman is employed at such theater and the total number of hours such fireman is employed by the city for all purposes.

It shall also be the duty of every person or corporation conducting, maintaining or operating a theater, to employ, in addition to the fireman employed by such person and detailed by the Fire Marshal, one other experienced and competent person as a private watchman or fireman, who shall be approved by the Fire Marshal; shall be in a distinctive uniform; shall be on duty at such theater during the whole time it is open to the public; shall report to and be subject to the orders of the Fire Marshal, and whose duty it shall be to see that the provisions of this chapter are complied with in all portions of the theater occupied and used by the public; shall see that all exit doors are unlocked during the whole time such theater is open to the public, and in efficient and ready working order. The city fireman and Fire Marshal shall require a drill of the employees of such theater, including such private watchman or fireman, in the use of all apparatus and appliances for the prevention of fire inside the building and the saving of life, at least twice in every week, and such city fireman shall report to the Fire Marshal the manner and efficiency of such drill. Such city fireman shall report in writing, daily, to the Fire Marshal the condition and equipment of the theater to which he is detailed. No city fireman shall be on duty at one theater for a longer period than two (2) weeks.

Sec. 381. (Amusement License.)—The amusement license issued for each theater shall state the number of permanent seats it contains, which number shall be governed by the provisions of this chapter relating thereto, and no more than that number of persons shall be permitted in such theater at any one time.

No license for the operation of a theater shall be issued unless the Commissioner of Buildings, Fire Marshal and City Electrician shall first have certified, in writing, that such theater complies with the provisions of this chapter in every respect.

Sec. 382. (Lighting.—All Parts Well Lighted During Performances.)—Every portion of any theater, devoted to the uses or accommodation of the public, and all outlets therefrom, to the streets, including open courts, corridors, stairways, exits and emergency exit stairways, shall be well and properly lighted during every performance, and the same shall remain lighted until the entire audience has left the premises.

Sec. 383. (Lights, Control of Lights in Halls, Corridors and Lobbies.—Separate Shut-off.—Connections With Gas Mains.—Independent Connections.—Protection of Suspended and Bracket Lights.—Protection of Lights Inserted in Walls.—Protection of Footlights.—Construction of Border Lights.—Ducts and Shafts Conducting Heated Air from Lights.—Gas Stage Lights to Have Metal Screens.)—All gas or electric lights in the halls, corridors, lobbies or any other part of any theater used by the audience, except the auditorium, shall be controlled by a separate shut-off located in the lobby and controlled only in that particular place. Gas mains supplying such theater shall have independent connections for the auditorium and the stage and provision shall be made for shutting off the gas from the outside of the building. All suspended or bracket lights surrounded by glass, in the auditorium, or in any other part of the theater, shall be provided with proper wire netting underneath. No gas or electric lights shall be inserted in the walls, woodwork, ceiling, or in any part of the theater unless protected by fireproof materials. In case gas is used, for the footlights, in addition to the wire network, they shall be protected by a strong wire guard, not less than two feet distant from such footlights, and the trough containing such footlights shall be formed of and surrounded by fireproof material. All border lights shall be constructed according to the best known methods, and subject to the approval of the Fire Marshal and the City Electrician, and shall be suspended by wire

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ropes. All ducts and shafts used for conducting heated air from the main chandelier, or from any other light or lights, shall be constructed of metal and made double, with an air space between. All gas stage lights shall have strong wire metal guards or screens, not less than ten inches in diameter, so constructed that any material coming in contact therewith shall be out of reach of the flames of such lights, and shall be soldered to the fixtures in all cases.

The use of calcium lights in any theater is prohibited. All arc lights used on the stage shall be at all times subject to the approval of the City Electrician, and no arc lights shall be used on any stage unless approved by the City Electrician.

Sec. 384. (Fire Apparatus to Be Under Control of Fire Department.)—The stand-pipes, automatic sprinklers, gaspipes, electric wires, hose, footlights, fire alarm boxes, fireproof proscenium curtains, switch boxes, ventilators, controlling levers, axes and pike poles, and all apparatus for the extinguishing of fire or guarding against same, as provided for by this chapter, shall be made and kept at all times in condition satisfactory to and under control of the Fire Marshal.

Sec. 385. (Officers Empowered to Enter Buildings.)—The Commissioner of Buildings, Fire Marshal, City Electrician, Superintendent of Police, or any of them, and their respective assistants, shall have the right to enter any buildings used wholly or in part for the purposes of Class V., and any and all parts thereof, at any reasonable time, and at any time when occupied by the public, in order to examine such buildings and to judge of the condition of the same and to discharge their respective duties, and it shall be unlawful for any person to interfere with them or any of them in the performance of their duties.

Sec. 386. (The Commissioner of Buildings, Fire Marshal, City Electrician or Superintendent of Police Shall Close Buildings for Violations.)—The Commissioner of Buildings, Fire Marshal, City Electrician or Superintendent of Police, or any of them, shall have the power and it shall be their joint and several duty to order any building used wholly or in part for the purposes of Class V. closed, where it is discovered that there is any violation of the provisions of this chapter, and to keep same closed until such provisions are complied with.

Sec. 387. (License.—Mayor Shall Revoke.)—Upon a report to the Mayor by the Commissioner of Buildings or Fire Marshal or City Electrician or the Superintendent of Police that any requirement of this chapter, or that any order given by them or any of them, in regard thereto, has been violated, or not complied with, the Mayor shall revoke the license of any such theater or place of public amusement so reported and cause the same to be closed.

ARTICLE IX.

PROVISIONS RELATING SOLELY TO CLASS VI

In Class VI. shall be included every tenement and apartment house; that is to say, any house or building, or portion thereof, which is used as a home or residence for two or more families living in separate apartments.

Sec. 388. (Walls of Class VI.—Thickness of.)—Buildings of Class VI. shall conform to the following requirements:

The thickness of enclosing walls of buildings of Class VI shall be made in accordance with the following table, to wit:

	STORIES											
	Basement.	1	2	3	4	5	6	7	8	9	10	11 12
Basement and	12	8										
Two-story	12	12	8									
Three-story	16	12	12	12								
Four-story	20	16	16	12	12							
Five-story	20	16	16	16	12	12						
Six-story	20	20	16	16	16	12	12					
Seven-story	24	24	20	20	16	16	12	12				
Eight-story	24	24	24	20	20	16	16	12	12			
Nine-story	28	24	24	20	20	20	16	16	12	12		
Ten-story	28	24	24	24	20	20	16	16	12	12		
Eleven-story	28	28	24	24	24	20	20	16	16	12	12	
Twelve-story	32	28	28	24	24	24	20	20	16	16	12	12

Provided, however, in buildings of steel skeleton fireproof construction, thickness of walls shall be governed by the provisions of Section 510 of this chapter.

Walls Around Stairs, Elevators and Shafts.—See Section 588.

Walls.—Reinforced Concrete.—See Section 554.

Sec. 389. (Definitions.)—"New tenement house" includes every tenement house hereafter erected and every such new tenement house which shall be increased or diminished in size or otherwise altered after its erection, and every building now or hereafter in existence not now used as a tenement house, but hereafter converted or altered to such use.

"Apartment" is a room or suite of two or more rooms occupied or intended or designed to be occupied as a family domicile.

"Yard" is an open, unoccupied space on the same lot with a tenement house, separating every part of every building on the lot from the rear line of the lot.

"Court" is an open, unoccupied space, other than a yard, on the same lot with a tenement house; a court entirely surrounded by a tenement house is an "inner court;" a court bounded on one side and both ends by a tenement house and on the remaining side by a lot line is a "lot line court;" a court extending to a street, alley or yard is an "outer court."

"Shaft" includes exterior and interior shafts, whether for air, light, elevator, dumb waiter or any other purpose; a "vent shaft" is one used solely to ventilate or light a water closet compartment, bath room, or pantry.

"Public Hall" is a hall, corridor or passageway, not within an apartment.

"Stair Hall" includes the stairs, stair landings, and those portions of the public halls through which it is necessary to pass in getting from the entrance floor to the top story.

"Basement" is a story partly, but not more than one-half—"Cellar" is a story more than one-half—below the level of the street grade nearest the building; where the grade of a street adjacent to a tenement house varies, the mean or average grade of such street opposite the lot containing the tenement house shall be regarded as the grade of such street within the meaning of this chapter.

"Story" is that portion of a building between the top of any floor beams and the top of the floor or ceiling beams next above.

A good quality of brick, laid in lime mortar, of strength and character equal to the requirements of Section 587 of this chapter, for brick walls, shall be taken as the standard of strength and stability for "solid masonry," but any other fireproof materials of equal strength and stability to the above standard may be substituted for brick.

Sec. 390. (Construction of Partitions Between Apartments in Frame Buildings.)—Every new tenement house more than five stories and basement high shall be of fireproof construction (according to the definition of "fireproof construction" contained in Section 500 of this chapter); every new tenement house more than three stories and basement high, but not more than five stories and basement high, shall be of "slow-burning" or "fireproof construction" (according to the definition of "slow-burning" or "fireproof construction" as defined in this chapter). In case slow-burning construction be used the cellar and basement construction, including the floor construction of the first story above the cellar or basement, shall be of fireproof construction. *In all new frame tenement houses outside the fire limits of the city each suite of apartments shall be separated from the next suite in such building by a wall of four-inch tile or metal studding and metal lath.*

As amended by ordinance of October 22, 1906.

In all new frame tenement houses outside the fire limits of the city, each suite of apartments shall be separated from the next suite in such building by a wall of incombustible material of such character as the Commissioner of Buildings may require.

Sec. 391. (Joists.—Supports for.)—If in buildings of Class VI. the distance between the enclosing walls is more than twenty-four feet in the clear, there shall be intermediate supports for the joists, which supports shall be either brick walls or iron or steel. If brick walls are used for this purpose they may, in all cases where the thickness of walls is given in the table as 16 inches or more, be made 4 inches less in thickness than the dimensions stated in the table.

Walls.—Ledges in.—See Section 588.

Sec. 392. (Fire Escapes.)—Every tenement house four or more stories in height shall be provided with a fire escape or fire escapes, such as are required by the statutes of this state and the ordinances of the city. In every case each separate apartment shall have direct access to at least one such fire escape unless such apartment shall have direct access (without passing through any other apartment) to at least two separate flights of stairs leading to the ground, one of which is placed in front and one in the rear of such building, and one of which may be placed outside of the building; but where such separate apartment shall not have access to two such flights of stairs, then there shall be a metal stairway between the balconies of every such fire escape, securely fastened to the walls of the building not less than two feet wide, with a proper hand rail, instead of the usual vertical ladder. Every court in which there shall be a fire escape shall have direct and unob-

structed access along the surface of the ground to a street, alley, or yard opening into the alley or street, without entering into or passing through or over any building, unless by a four-foot wide fireproof passage on the court or ground level.

Sec. 393. (Fire Escapes to Be Painted.)—Every new fire escape shall be painted with two coats of durable paint, one put on in the shop and the other at once upon the erection of such fire escape.

Sec. 394. (Bulkheads and Scuttles.—Stairs to.)—Every tenement house shall have in the roof a bulkhead or scuttle, fireproof or covered with fireproof materials, with stairs or ladder leading thereto; no such roof opening shall be less than two feet by three feet. No scuttle or bulkhead door shall have upon it any lock, but may be fastened on the inside by movable bolts or hooks.

Sec. 395. (Stairs and Halls.—In Case of Alterations.—Requirements.)—Every now existing and every new tenement house shall have at least two flights of stairs, which shall extend from the entrance floor to the top story. Such stairs and the public halls in every tenement house shall each be at least three feet wide in the clear, and every apartment shall be directly accessible from both such flights of stairs. If any existing tenement house be so altered as to increase the number of apartments therein, or if such building be increased in height, or if the halls and stairs therein be damaged by fire or otherwise to an extent greater than one-half the original cost thereof, the entrance, stair halls, entrance halls and other public halls of the whole building shall be made to conform to the requirements of this chapter as to new tenement houses.

Sec. 396. (Railings and Guards.)—In every tenement house all stairways shall be provided with sufficient railings and guards.

Sec. 397. (Stairs in Non-Fireproof Buildings, Eighty to One Hundred and Twenty Rooms.)—Every new non-fireproof tenement house containing over eighty rooms, exclusive of bath rooms, shall have one additional flight of stairs (over and above the flights hereinbefore provided for) for every additional eighty rooms, or fraction thereof; but if such building contains not more than one hundred and twenty rooms, exclusive of bath rooms, at the owner's option, in lieu of an additional stairway, the stairs and public halls throughout the entire building shall be at least one-half wider than is provided in Sections 395 and 402 of this chapter.

Sec. 398. (Stairs in Fireproof Buildings One Hundred and Twenty Rooms and Upward.)—Every new fireproof tenement house containing over one hundred and twenty rooms, exclusive of bath rooms, shall have one additional flight of stairs (over and above the flights hereinbefore provided for) for every additional one hundred and twenty rooms or fraction thereof; but if such building contains not more than one hundred and eighty rooms, exclusive of bath rooms, at the owner's option, in lieu of an additional stairway, the stairs and public halls throughout the entire building shall be made at least one-half wider than is provided in Sections 395 and 402 of this chapter.

Sec. 399. (Stairs.—Entrance to.—Treads and Risers.)—Every flight of stairs required in a tenement house shall have an entrance on the entrance floor from a street or alley, or from a yard or court which opens into a street or alley. All stairs except rear stairs, in new tenement houses, shall have risers not more than seven and three-quarters inches high and treads not less than nine and one-half inches wide exclusive of nosings, except in winding stairs, where all treads at a point eighteen inches from the strings on the well side shall be at least nine and one-half inches wide, exclusive of nosings.

Sec. 400. (Stairs and Stair Halls.—Over Three Stories.—Fire-Resisting Glass.)—The stairs and stair halls in all new tenement houses more than three stories and basement high shall be constructed of incombustible material throughout, except that the treads of stairs (not less than one and three-fourths inches thick) and all hand rails, may be of hard wood. All windows in stair halls in new tenement houses more than three stories and basement high opening on inner courts or shafts shall be of good quality fire-resisting glass.

Sec. 401. (Stair Halls Enclosed in Masonry.—Requirements and Exceptions.)

Amended by ordinance of February 18, 1907, to read as follows:

In every new non-fireproof tenement house all stair halls shall be enclosed on all sides with the walls of solid masonry of the same dimensions and thickness as specified for enclosing walls. All windows in such stair halls shall have metal frames and sashes, glazed, fire-resisting glass and such windows shall be stationary. This section shall not apply to tenement houses which are not more than three (3) stories and basement high with only one apartment on each floor.

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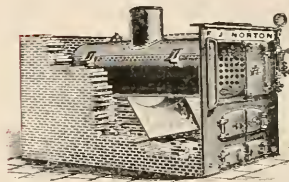
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Sec. 402. (Entrance Halls.—Solid Masonry.—Exceptions.—Ceilings.)—Every main entrance hall in a new tenement house shall be at least three feet six inches wide in the clear from the entrance up to and including the stair enclosure, and beyond this point at least three feet wide in the clear. In every new non-fireproof tenement house, except where there is only one apartment on each floor, such entrance hall shall be inclosed with solid masonry walls and with ceilings covered with incombustible material and shall comply with all the conditions of the preceding sections of this chapter as to the construction of stair halls. If such main entrance hall is the only entrance to more than one flight of stairs, the several portions of such main entrance hall which separate the entrance of the building from the several flights of stairs respectively shall be increased respectively at least one foot in width for each additional flight of stairs.

Sec. 403. (Frame Buildings Not to Be Enlarged.)—No wooden frame tenement house within the fire limits shall be enlarged either by adding to its height or to its superficial area.

Sec. 404.—(Bay Windows—Vent Shafts.—Openings.)

Amended by ordinance of February 8, 1907, to read as follows:

All bay windows and all shafts and courts, in masonry constructed new tenement houses, shall have the walls of the bay windows, shafts and courts built of brick or other fireproof construction throughout. This section shall not apply to enclosures about elevators which are in common with a stairway surrounded and enclosed in masonry walls.

Sec. 405. (Apartments Divided by Masonry.)—There shall be a wall of solid masonry of the same thickness as required for outside walls in buildings of this character, extending from the ground to the roof between each set of apartments and around each well hole, court or light shaft; provided, however, that the wall between apartments above the first story extending from a main stair hall to the outer wall of the building may jog or set over to some point toward the center of the building to provide or allow for an even distribution of space of the rooms adjacent to the same; provided, however, that such wall above the first story, if supported on iron or steel beams (which shall extend from the brick wall surrounding the main stair hall to the outer wall of the building at each succeeding story), shall be not less than eight inches in thickness, but all brick walls between apartments and around each well hole, court or light shaft which extend from the ground to the roof and above the first story of an apartment building not supported as above described in this section, shall be of the thickness prescribed for buildings of this class in Section 388 of this chapter.

Sec. 406. (Space Occupied on Lot.—Plat Measurements.)—No new tenement house, alone or with other buildings now or hereafter erected, shall occupy above the first story more than eighty-five per centum of the area of a corner lot or more than ninety per centum of the area of such corner lot, if such corner lot is bounded on three sides by streets or alleys, or more than seventy-five per centum of the area of any other lot, provided, that the space occupied by fire escapes, constructed and erected according to law and not more than four feet wide, shall be deemed unoccupied.

At the time of applying for a permit for the erection of a new tenement house the applicant shall submit a plat of the lot showing the dimensions of the same and the position to be occupied by the proposed building, and the position of any other building or buildings that may be on the lot. The measurements shall in all cases be taken at the top of the first story and shall not include any portion of any street or alley.

Sec. 407. (Corner Lot Defined.—Frontages.—Triangular Lots.)—By "corner lot" is meant a lot situated at the junction of two streets or of a street and public alley not less than sixteen feet in width. Any portion of the width of such lot distant more than fifty feet from such junction shall not be regarded as part of a corner lot, but shall be subject to the provisions of this chapter respecting other than corner lots.

Where, in corner lots, the two frontages are of unequal length, the lesser street frontage shall be taken as the width of the lot. Street frontage alone and not alley frontage shall be considered in determining such lesser frontage. No existing tenement house shall hereafter be enlarged or its lot be diminished or other buildings be placed on its lot, so that after such change a larger proportion of any corner lot or other lot upon which it is situated is covered by buildings than the aforesaid proportions, respectively; provided, however, that in case of a lot triangular or irregular in shape, bounded on two or more sides by a street and having a number of lineal feet street frontage *exceeding* one-twentieth of the number of square feet in the area of such lot, it shall not be necessary to comply with the conditions of this sec-

tion as to percentage of lot to be covered; and provided, further, that there shall be no violation of Section 411 of this chapter in the erection of any tenement house.

Amended October 22, 1906, by the substitution of the word "exceeding" in lieu of the word "extending," in fourth line from bottom of section.

Sec. 408. (Fire Walls.—When Dispensed With.)—Fire walls of brick not less than twelve inches thick shall be built, extending above the roofs of all adjoining buildings, if such roofs are flat, and also where the building stands upon any line of any lot, excepting street or alley lines. Provided, that where eight-inch walls are permitted in the top story of buildings, or where the building is not over three stories high, the fire walls may be eight inches thick. Such fire walls, where they stand upon lot lines or where they are over the dividing walls between buildings or over the dividing walls in the interior of buildings, where such are called for by this chapter by reason of the great area of such buildings, shall extend at least two feet above the roofs of such buildings. Fire walls upon street and alley lines shall extend not less than eighteen inches above the roofs of such buildings. Fire walls may be dispensed with on street and alley lines, if the top of the roof boards and roof joists are protected against fire for a distance of at least five feet from such street or alley lines by a coating of mortar or hollow tile or porous tile at least two inches thick. Fire walls at street and alley lines may also be dispensed with in all cases where the entire framing and material of the roof shall be made strictly fireproof.

Walls facing upon courts and light shafts shall be treated as in the same category with walls facing upon streets and alleys.

Fire walls shall be covered with a weatherproof coping of incombustible material.

Sec. 409. (Height.—How Measured.)—The height of a new tenement house shall not by more than one-half exceed the platted width of the widest street on which it abuts.

Provided, however, that any distance the building sets back from the lot line shall be added to the width of the street in making this computation, but no existing tenement house shall be increased beyond such height. Such height shall be the perpendicular distance from the grade nearest the house to the highest point of the roof (not including as part of the roof any cornice or bulkhead less than eight feet high, or any elevator enclosure less than sixteen feet high). Where such street grade varies, the mean or average grade thereof opposite such house shall be the datum from which such height shall be measured.

Sec. 410. (Alley or Yard in Rear.—Must Have.—Size of Yard Increased.)—At the rear of every lot containing a new tenement house (unless the rear of such lot abuts upon a public alley at least ten feet wide) there shall be a yard open and unobstructed from the earth to the sky, except by fire escapes not more than four feet wide, constructed and erected according to law; every part of such yard shall be directly accessible from every other part thereof; such yard shall on corner lots (as above defined) have an area of at least eight per centum of the superficial area of the lot, and shall on other lots have an area of at least ten per centum of the superficial area of the lot. Every such yard shall be increased one per centum of the superficial area of the lot for every story above three stories in height of the tenement house situated thereon, and in no case shall such yard separate any building on such lot by less than ten feet from the rear line of the lot at the nearest point of approach of such building to such rear line.

For the purpose of construing and enforcing this section, the rear of the lot shall be held and deemed to be that part of the lot that is farthest from the line of the street upon which the proposed building will face, and in case where the proposed building will stand upon a corner lot or tract of land abutting upon two streets and an alley, in all such cases the proposed building or buildings may extend from the front to the rear of such lot or tract. Nothing herein contained shall conflict with or modify any other provision of this ordinance.

As amended by ordinance January 8, 1906.

Sec. 411. (Requirements in Case of Enlarging.—Distance Between Buildings.)—No existing tenement house shall (unless the rear of the lot upon which it stands abuts upon a public alley at least ten feet wide) hereafter be enlarged or its lot be diminished so that any building on such lot shall at any point approach nearer than ten feet to the rear line of the lot. Where a tenement house, now or hereafter erected, stands upon a lot, other than a corner lot, no other building shall hereafter be placed upon the front or rear of that lot, unless the minimum distance between such buildings be at least ten feet, if neither building exceeds the height of one story; or fifteen feet, if either building exceeds the height of one story, but not the height of two stories; and so on, five additional feet to be added to such minimum distance of ten feet for every story more than one in the height of the highest building on such lot.

Sec. 412. (Courts, Porches.)—Every court of every new tenement house shall be open and unobstructed at every point thereof from the bottom thereof to the sky, save by fire escapes or stairs or landings constructed and erected according to law and projecting not more than four feet into courts, which courts shall communicate directly without obstruction into a street, alley or yard. Where porches are constructed in courts, the amount of area of unobstructed space in such courts shall be exclusive of space occupied by stairs and porches. No rear porch shall be constructed which is more than eight feet in width where the construction is of combustible material, and no such rear porches shall be enclosed with other than incombustible material, as defined in Section 506 of this chapter.

Sec. 413. (Rooms.—Habitable.—Windows.—Vent Shafts.)—In every new tenement house every habitable room, excepting water closet compartments and bath rooms, shall have at least one window opening directly upon a street, alley, yard or court. The total area of the windows opening from any such room (other than water closet compartments and bath rooms) upon a street, alley, yard or court, shall be at least one-tenth of the floor area of that room, and the top of at least one window shall be not less than seven feet above the floor and the upper half of that window shall be made so as to open its full width. No window in any such room (other than pantries, water closet compartments and bath rooms) shall have less than ten square feet glass area, and in no such water closet compartment or bath room shall the total window area be less than three square feet glass area, or the width of any window less than one foot; and when any window ventilating any water closet compartment or bath room in any new tenement house opens into a vent shaft, no window from any room other than a water closet compartment, bath room, pantry or hall shall open into such vent shaft.

Sec. 414. (Windows in Lot Line Walls.)—Windows in addition to those provided for in Section 413 of this chapter, if placed in any lot line wall or in any wall nearer to the lot line than is specified in Section 416 of this chapter from such lot line, then the sash in such window shall be stationary and glazed with fire-resisting glass.

Section 414 repealed in its entirety by ordinance of February 18, 1907 (page 3336, Council Proceedings).

Sec. 415. (Courts.—Inner.—Sizes Of.—Lot Line Courts.)—The "inner courts" of all new tenement houses as defined in Section 389 of this chapter shall have areas and minimum widths in all parts not less than the widths and areas as follows:

Buildings.	Square Feet.	Least Width.
2 stories.....	100	6 feet
3 stories.....	120	7 feet
4 stories.....	160	8 feet
5 stories.....	250	12 feet
6 stories.....	400	16 feet
7 stories.....	625	20 feet
8 stories.....	840	24 feet

"Lot line courts" shall have areas and minimum widths in all parts not less than one-half of those specified in the above table of "inner courts."

Sec. 416. (Courts.—Outer.—Sizes Of.—Width Increased.)—The "outer courts" of all tenement houses defined in Section 389 of this chapter shall have not less than the following widths for their minimum in all parts:

Buildings.	Least Width.
2 stories.....	3 feet
3 stories.....	3 feet 6 in.
4 stories.....	4 feet
5 stories.....	6 feet
6 stories.....	8 feet
7 stories.....	10 feet
8 stories.....	12 feet

If the outer or lot line court has windows on opposite sides of the same, the least widths given in the above table for outer courts shall be doubled.

Sec. 417. (Rooms.—Sizes and Height of.—Attic and Janitor's Rooms.)—In every new tenement house, all rooms, except water closet compartments and bath rooms, shall be of the following minimum sizes: In each apartment there shall be at least one room containing not less than one hundred and twenty square feet of floor area, and every other room shall contain at least seventy square feet of floor area. Each room shall be in every part not less than eight feet six inches high from the finished floor to the finished ceiling, but an attic room need be eight feet six inches high in but one-half of its area; provided, that in a basement apartment used for janitor's use only, such room or rooms shall be not less than eight feet high in the clear.

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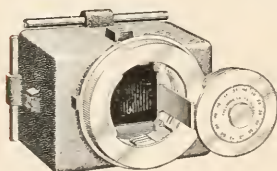
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Sec. 418. (Rooms.—Changes in Existing.)—No room in any now existing tenement house shall hereafter be constructed, altered, converted or occupied for living purposes unless it contains a window having a superficial area not less than one-twelfth the floor area of the room, which window shall open upon a street or alley or upon a yard or court having a superficial area of not less than twenty-five square feet; or unless such room adjoins another room in the same apartment, which other room shall have such a window opening upon such a street, alley, yard or court, and between which two adjoining rooms there shall be a sash window having at least fifteen square feet of glazed surface, the upper half of which shall be so made as to open easily.

Sec. 419. (Windows.—Courts.—Attic.)—No room in any now existing tenement house which has no such window, as aforesaid, opening upon a street or alley or upon a yard or court having a superficial area of not less than twenty-five square feet, shall hereafter be constructed, altered, converted or occupied for living purposes, unless it contains a floor area of at least sixty square feet and also at least six hundred cubic feet of air space; nor unless every part of the finished ceiling of such room be at least eight feet distant from every part of the finished floor thereof; provided, that an attic room need be eight feet high in but one-half of its area and such attic room shall not be used for purposes of human habitation other than as a sleeping room.

Sec. 420. (Air.—Quantity of for Each Person.)—No room in any tenement house shall be so occupied that the allowance of air to each person living or sleeping in such room shall at any time be less than four hundred cubic feet for each such person more than twelve years old, and two hundred cubic feet for each such person of the age of twelve years or under.

Sec. 421. (Alcoves.)

Amended by ordinance of February 18, 1907, to read as follows:

Alcove rooms must conform to all the requirements of other rooms, except that in one or two-story existing buildings which it may be desired to raise or alter, every alcove shall be deemed a separate room for all purposes within the meaning of this ordinance, except such an alcove as, adjoining another room, has at least twenty per centum of entire wall surface of alcove opening to another room.

Sec. 422. (Light in Halls.—Recesses.—Returns.—Doors In.)—In every new tenement house every public hall shall be lighted by at least one window in each story opening directly upon a street, alley, yard or court, or by a skylight. Such window shall be so placed that light may pass directly through it and the hall to the opposite end of the hall, or else there shall be at least one window opening directly upon a street, alley, yard or court in every twenty feet in length or fraction thereof of every such hall, except in so much of any entrance hall as lies between the entrance and the flight of stairs nearest the entrance. In any such public hall, recesses or returns, the length of which do not exceed twice the width of the hall, will be permitted, without an additional window, but otherwise each recess or return shall be regarded for the purposes of this section as if it were a separate hall. Any part of a public hall which is shut off from any other part by a door or doors shall be deemed a separate public hall within the meaning of this section.

Sec. 423. (Public Halls.—Windows In.)—In every new tenement house one at least of the windows provided to light each public hall or part thereof shall have a glass area of at least twelve square feet.

Sec. 424. (Rooms and Halls.—Additional.)—Any additional room or hall that may hereafter be constructed or created in an existing tenement house shall comply in all respects with the provisions of this chapter as to size, arrangement, light and ventilation of rooms and halls.

Sec. 425. (Shafts.—Inner and Outer Vent.—Dimensions.)—Inner or outer vent shafts of all tenement houses as defined in Section 389 of this chapter shall be of the following dimensions:

Building.	Square Feet.	Least Width.
2 stories.....	22½	3 feet
3 stories.....	27	3 feet
4 stories.....	36	3 feet
5 stories.....	48	5 feet
6 stories.....	72	6 feet
7 stories.....	96	8 feet
8 stories.....	120	8 feet

Sec. 426. (Skylight Over Stairs.—Ventilating.—Area Of.)—In every new tenement house there shall be in the roof, directly over each stair well, a ventilating skylight, which shall have a glazed surface of the following dimensions: Where such tenement house shall not exceed two stories in height, and covering a superficial ground area of not to exceed sixteen hundred square feet, the glazed surface in such ventilating skylight shall be not less than fifteen square feet in area. For a three-story building, with a superficial ground area of not to exceed sixteen hundred square feet, the glazed surface of such ventilating skylight shall be not less than twenty square feet in area. For all buildings in excess of three stories and covering a superficial ground area in excess of 1,600 square feet, the glazed surface of such ventilating skylight shall be not less than twenty-five square feet in area; provided, however, that such ventilating skylights shall not be required in any of such buildings where the stairways are lighted by a window on each story landing.

If the building is more than three stories high, the skylights shall have at least six inches above same a strong wire netting (wire not lighter than No. 8 and a mesh not coarser than one and one-half by one and one-half inches) unless the glass contains a wire netting within itself.

Sec. 427. (Flues in Walls.)—In every new tenement house there shall be adequate flues in walls of masonry not less than forty-nine square inches area in each chimney running through every floor, with an open fireplace or grate or place for a stove, properly connected with one of such chimney flues, for every apartment, every additional flue used shall not be of less size than the above.

Sec. 428. (Cellar and Basement.—Ceilings.—Ventilation.)—All cellar and basement ceilings, unless the floor construction be fireproof, shall be plastered, and that part of the ceiling over the boiler or furnace extending two feet beyond in each direction shall be covered with metal lath and shall be plastered with cement, and every cellar shall be ventilated from both ends.

Sec. 429. (Damp-Proofing.—Basement Walls and Floors.)—Every new tenement house shall have all its outside walls below the adjacent ground level plastered on the outside with Portland cement or treated with other approved damp-proofing material, and such walls, as high as the ground level, shall be laid in cement mortar. The basement or cellar shall have a floor of Portland cement concrete not less than three inches in thickness.

Sec. 430. (Cellar Changed for Living Purposes.—Requirements.—Height.)—In no now existing or new tenement house shall any room in the cellar be constructed, altered, converted or occupied for living purposes; and no room in the basement of a tenement house shall be constructed, altered, converted or occupied for living purposes, unless all of the following conditions of this chapter be complied with, and at least one-third of the height of the basement shall be above grade for building; provided, in each case it shall be at least four feet above the street grade. Such rooms shall be at least 8 feet 6 inches high in all now existing or new tenement houses in every part, from floor to the ceiling, except as provided for janitor's use only in Section 417 of this chapter.

Sec. 431. (Water Closet.)—There shall be appurtenant to such room or apartment, a water closet conforming to the regulations and ordinances of the city relating to water closets.

Sec. 432. (Shafts, Areas, Etc., to Extend Two Inches Below the Floor.—Graded.—Concreted.—Drained.)—In every new tenement house, the bottom of all shafts, courts and yards which extend to the basement and light and ventilate the living rooms in such basement shall, by means of areas, not less than two feet six inches in their least dimension or otherwise, be extended a distance of at least two inches below the floor level of the part intended to be occupied. All shafts, inner courts and areas which extend to the ground shall be properly concreted, and all shafts, inner and lot line courts and areas shall be properly graded and drained, and shall be so connected with a street sewer through an intermediate trap or surface basin (where such a sewer is adjacent to the lot), that all water may be drained freely into it.

Sec. 433. (Sinks.—Requirement.)—In every new tenement house there shall be in each apartment at least one proper sink with running water. In every now existing tenement house there shall be on every floor at least one proper sink with running water, accessible to all the tenants of that floor, without passing through any other apartment, if there be not one such sink in each apartment. In no tenement house shall there be woodwork inclosing sinks located in the public halls; the space underneath sinks shall be left entirely open.

Sec. 434. (Water Closets.—Access to.—Windows in.—Artificial Light.)—In every new tenement house there shall be a separate water closet in a separate compart-

ment within each apartment, accessible to each apartment, without passing through any other apartment, provided that where there are apartments, consisting of only one or two rooms, there shall be at least one water closet for every two apartments. Every water closet compartment in every new tenement house shall have a window opening upon a street, alley, yard, court or vent shaft, and every water closet compartment in every existing tenement house shall be ventilated by such a window, or else by a proper ventilating pipe running through the roof. Every water closet compartment in every tenement house shall be provided with proper means of artificially lighting the same. If fixtures for gas or electricity are not provided in any such compartment, then the door thereof shall have ground glass or wire glass panels or transoms.

Sec. 435. (Sanitary Requirements.)—No drip trays shall be permitted in new tenement houses. All water closet fixtures in every new tenement house shall be constructed and set up comfortably to the requirements of the Department of Health. All privy vaults used in connection with any existing tenement house shall be replaced by water closets, constructed and set up in conformity with the provisions of this chapter, whenever connection with a public sewer is in any way practicable, and the Department of Health of the city shall be the sole judge as to the practicability of such connection with the public sewer. At least one such water closet shall be provided for every two apartments in each existing tenement house, and such water closets may be located in the yard if necessary. If so located, long hopper closets may be used, provided all traps, flush tanks and pipes be protected against frost.

Sec. 436. (Loads.—Allowance for Live Loads in Construction of Floors.)—For all buildings of Class VI. the floors shall be designed and constructed in such a manner as to be capable of bearing in all their parts, in addition to the weight of the floor construction, and including the weight of partitions and permanent fixtures and mechanisms that may be set upon the same, a live load of forty pounds for every square foot of surface in such floors.

Sec. 437. (Pipes Through Floors.)—In every new tenement house where plumbing or other pipes pass through floors or partitions, the openings around such pipes shall be sealed or made air tight with plaster or other incombustible material, so as to prevent the passage of air or the spread of fire from one floor to another or from room to room.

Sec. 438. (Catch Basins.)—The covers of all catch basins in lots containing tenement houses shall be of stone or iron, and shall be placed in courts or yards flush with the surface of such courts or yards, so that access to such basins may be convenient.

Sec. 439. (Stairways.—Fire Escapes to be Free From Incumbrance.)—No incumbrance of any kind shall at any time be placed before, upon or against any stairway, steps or landings or fire escapes in or upon any tenement house. All fire escapes upon tenement houses shall be kept in good order and repair, and every exposed part thereof shall at all times be protected against rust by durable paint.

Sec. 440. (Water Closets.—Access To.)—In every apartment of three or more rooms in every new tenement house convenient access from the outer door of the apartment to every living room and to every bedroom, and to every room used as a bedroom, and to at least one water closet compartment, shall be provided otherwise than through any bedroom or room used as a bedroom.

Sec. 441. (Buildings Damaged by Fire, Etc.)—If any existing tenement house is hereafter damaged by fire or other cause (including ordinary wear) so that at any time its value be less than one-half its original cost (exclusive of the value of the foundations) such building shall not be repaired or rebuilt except in conformity with the provisions of this chapter applicable to new tenement houses.

Sec. 442. (Changes or Alterations.—Permits.)—Every new tenement house and all changes or alterations in any existing tenement house shall conform to the requirements of this chapter. No new tenement house shall be begun, nor shall any changes or alterations in any existing tenement house, such as are referred to in this chapter, be begun until a permit therefor shall have been issued by the Building Department of the city. Such permit shall be issued only upon an application by the person for whom the building is to be erected or altered, and after approval of the plans and specifications of such tenement house, or such changes or alterations by the Health Department of the city whenever such approval is required by law or ordinance.

Sec. 443. (Notice to be Sent to Commissioner of Buildings to Inspect.—Certificate to be Issued.—Notice to Inspect to be Filed.)—It shall be the duty of the owner

or his agent, when a tenement house is in course of erection, to notify the Commissioner of Buildings of the city when the building is or will be ready for lathing, and the Commissioner shall, within three days of the time specified, cause an inspection to be made, and if the construction is found to be in accordance with the requirements of this chapter he shall issue or cause to be issued a certificate to that effect; otherwise he shall cause the penalties provided in Section 445 of this chapter to be enforced. The Commissioner shall file for reference the notice received and shall also file a copy of the certificate in the office of the Building Department.

Sec. 444. (Yards, Courts, Etc.—Must Comply as to.)—Any tenement house not conforming in itself and in its yards, courts, areas and shafts to the requirements of this chapter shall not be occupied, or if found occupied shall forthwith be vacated upon notice from the Commissioner of Buildings, and such tenement house shall not again be occupied until made to conform in all respects with the provisions of this chapter, notwithstanding the issuance of a building permit for the erection or alteration of such building.

Sec. 445. (Violations.—Penalty For.)—Any owner, lessee, tenant, occupant or agent of any tenement house, or any architect, contractor, builder or foreman superintending or in charge of the work of construction of any tenement house violating, disobeying, neglecting or refusing to comply with or resisting the enforcement of any of the provisions of this chapter shall be fined not less than ten dollars nor more than two hundred dollars for each offense, and any violation of any provision of this chapter, if continued after the first fine is imposed, shall, for every week of such continuance, be punishable by an additional fine of not less than ten dollars nor more than two hundred dollars.

Sec. 446. (Provisions of this Chapter not to Apply to Existing Buildings, Except Under Certain Circumstances.)—Nothing in this chapter contained shall be considered as requiring alterations in the construction or equipment of buildings in existence at the time of the passage of this ordinance, and which at the time of their construction were built in compliance with the ordinances then in force, unless such building shall not have sufficient or adequate means of egress therefrom or ingress thereto by reason of insufficient or inadequate stairway or stairways improperly located or insufficient or inadequate elevators or elevator equipment, doors, fire escapes, windows or other means of egress or ingress.

If, however, it is desired to enlarge or in any manner materially modify the construction of any existing building, or to make any change in its use or occupation which will transfer it from one class, as defined by this chapter, to another class, then before such enlargement or structural change or modification of building is made, or before such change in its use or occupation may be made, the entire building shall be reconstructed or modified in such manner as to bring the same, when enlarged or altered, or when occupied for its new and different purposes, into accordance with the provisions of this chapter.

Sec. 447. (Commissioner Shall Notify.)—Where it shall appear to the said Commissioner that any such building has inadequate or insufficient means of egress therefrom or ingress thereto, as aforesaid, he shall notify the owner, agent or person in possession, charge or control of such building, of such fact, and direct him forthwith to make such alterations and changes in the construction or equipment of such building as are necessary to be made in order to promote the safety of the occupants of such building and of persons using the same and of the public.

Sec. 448. (Where Conflicting with Other Sections.)—In cases of direct conflict with the provisions of other sections of this chapter relating to other classes, the provisions of the sections relating to Class VI. shall govern in respect to tenement houses.

ARTICLE X

PROVISIONS RELATING SOLELY TO CLASS VII.

In Class VII. shall be included all buildings used for the sale at retail of dry goods and other articles of general merchandise and commonly known and described as "department stores."

Sec. 449. (Buildings of Class VII.—Construction Of.)—Buildings used either wholly or in part for the purposes of Class VII. three stories or less in height may be of ordinary construction.

Such buildings more than three and not exceeding five stories in height shall be of slow-burning, mill or fireproof construction.

Such buildings over five stories in height shall be of fireproof construction.

Sec. 450. (Walls.—Thickness Of.)—The thickness of inclosing walls shall conform to the following requirements:

	Basement.	STORIES										
		1	2	3	4	5	6	7	8	9	10	11 12
One-story	12	12										
Two-story	16	12	12									
Three-story	16	16	12	12								
Four-story	20	20	16	16	12							
Five-story	24	20	20	16	16	16						
Six-story	24	20	20	20	16	16	16					
Seven-story	24	20	20	20	20	16	16	16				
Eight-story	24	24	24	20	20	20	16	16	16			
Nine-story	28	24	24	24	20	20	20	16	16	16		
Ten-story	28	28	28	24	24	24	20	20	20	16	16	
Eleven-story	28	28	28	24	24	24	20	20	20	16	16	16
Twelve-story	32	28	28	28	24	24	20	20	20	16	16	16

Provided, however, in buildings of steel skeleton, fireproof construction thickness of walls shall be governed by Section 510 of this chapter.

Walls, Ledges, Etc.—See Section 588.

Walls Around Stairs, Elevators and Shafts.—See Section 588.

Walls Reinforced (Concrete).—See Section 551.

Sec. 451. (Stories Used for the Retail Sale of Goods.—Occupation of Basement.—Lockers.)—Not more than the lower twelve stories above the street grade shall be used for the retail sale of goods, or for employees' locker rooms or for manufacturing purposes in a building devoted wholly or in part to purposes of Class VII., provided, however, the stories above the twelfth story may be used for these or other purposes when the stairs are built as described in Section 457 of this chapter.

Not more than one floor of any basement or cellar shall be used for the retail sale of goods. Such floor shall be the floor nearest to the inside street grade. Such floor used for the retail sale of goods shall not be more than twenty feet below the inside street grade.

No sub-basement, cellar or part of a basement below such floor shall be used for the sale of any goods in any manner, but locker and dressing rooms may be placed in the sub-basement, provided the space thus occupied be separated from the remainder of the basement by fireproof partitions, and that there be at least two flights of stairs placed as far apart as practicable leading therefrom to the first floor inclosed in fireproof partitions as provided in Sections 533 and 534 of this chapter. Such stairs from such locker or dressing rooms shall be in addition to other stairways required by this chapter in such building, provided that at least one of such stairways shall open directly on a street, alley or court opening on a street or alley or a fireproof passage leading to the street, alley or such court. Where more than five lockers are in one room such lockers shall be of incombustible material.

Sec. 452. (Floor Areas.—Maximum.)—The floor area of any one story or portion of a story used for the purposes of Class VII. of any building of ordinary construction shall not exceed nine thousand square feet.

The floor area of any one story or portion of a story used for the purposes of Class VII. of any building of slow-burning or mill construction shall not exceed twelve thousand square feet.

The floor area of any one story or a portion of a story used for the purposes of Class VII. of any building of fireproof construction shall not exceed 25,000 square feet.

Sec. 453. (Floor Areas.—Exceeding the Maximum Limits Defined in Section 452.)—Where any floor or portion of a floor used for the purposes of Class VII. in any building shall exceed in area the maximum number of square feet allowed in the preceding section for the type of construction of such building in which such floor is contained, each such maximum amount of floor area so used shall be separated from other parts of such floor by fire walls or dividing walls built in accordance with the provisions of Section 259 of this chapter relating to dividing walls in buildings of Class I.

Where any such floor so used is divided by such fire walls or dividing walls, each such division of such floor shall be provided with stairs, aisles, exits and fire escapes, as is required in this chapter for separate and distinct buildings, and each such division shall be considered as a separate building.

Sec. 454. (Galleries.)—The area of any one or all of the galleries, mezzanine or intermediate floors in any one story used wholly or in part for the purposes of

Class VII. in any building shall not exceed 10 per centum of the area of such story, and galleries, mezzanine or intermediate floors of a larger size than the above shall be considered as full stories.

Every gallery, mezzanine or intermediate floor shall have at least one stairway not less than three feet wide.

The height from the floor of any gallery, mezzanine or intermediate floor to the ceiling over same shall not be less than seven feet, and there shall be not less than seven feet space between the bottom of such gallery, mezzanine or intermediate floor, and the floor of the story in which such gallery, mezzanine or intermediate floor is placed.

Every gallery, intermediate or mezzanine floor used for the purposes of Class VII. in any building shall be built entirely of fireproof or incombustible construction with the exception of the floor surface and nailing strips, which may be of wood.

No gallery, intermediate or mezzanine floor shall be built without a permit from the Department of Buildings, and plans showing the construction and size of such proposed gallery, intermediate or mezzanine floor shall be filed with the Department of Buildings when a permit is applied for.

Sec. 455. (Courts of Class VII. Buildings.)—Every court or light shaft of every building used wholly or in part for the purposes of Class VII. shall be open and unobstructed from the floor of such court to the sky, with the exception that fire escapes may be built therein, and such court shall have walls constructed in the same manner as is required for the exterior walls of such buildings; provided, that no walls inclosing such courts are required on street or alley lot lines.

All windows, doors or other openings in court walls of such buildings shall have metal frames, metal sashes and metal doors, with the glazed portion thereof of fire-resisting glass.

Sec. 456. (Stories.—Numbering Of.)—The first story above the inside street grade shall be designated and known as the first story for all purposes of this chapter, and the stories above shall be numbered, consecutively, the second, third, and so on.

Sec. 457. (Stairways.—Interior Stairways in Buildings of Class VII.)—Buildings used wholly or in part for purposes of Class VII. shall have two stairways if the aggregate floor area is five thousand square feet or less, three stairways if the aggregate floor area is more than five thousand square feet and not more than ten thousand square feet, and four stairways if the floor area is more than ten thousand square feet.

The number of stairways and the aggregate width of stairways required for the various floor areas shall be as indicated in the table hereinafter set forth in the following section.

The width of the different stairways need not be alike, and for each four stories, or fractional number of stories, of the building above the first four stories, each stairway may be reduced by six inches, as set forth in the table of stairs in Section 458, but no stair in a Class VII. building shall be of a less width than three feet.

Stairways in buildings used wholly or in part for the purposes of Class VII. shall be located as far apart as practicable, and shall have hand rails on each side thereof, and no such stairway shall be a spiral stairway or have any winders. The height of the individual riser shall not exceed seven and three-eighths inches. The width of the individual tread shall be not less than ten inches. Stairways which are over seven feet wide shall have double intermediate hand rails with end newel posts at least five and one-half feet high.

The bottom of each stairway shall be in the immediate vicinity of the top of the stairs leading to the next lower story, and the line of travel from stairway to stairway shall be direct and easily accessible each to the other.

Every story below street grade shall have not less than two stairways to the first story and each such stairway shall be not less than three feet wide, but where a basement or a cellar is used for the retail sale of goods the stairways from such basement or cellar shall be in number and aggregate width as indicated in the table of stairways set forth in the following section for the lower four stories of the same building.

The whole number of stairways required for any such building shall be complete in every respect from the first floor to the topmost floor, and each stairway shall be extended to the roof.

Provided, however, that if any building used wholly or in part for the purposes of Class VII., be equipped with automatic sprinklers, and be connected with another building similarly used, and distant not less than twenty-five feet, and used by the same occupant, by a fireproof bridge or passageway similarly equipped, then each such bridge or passageway

shall be held to be equivalent to and take the place of one outside stairway fire escape on each of the buildings so connected.

As amended by ordinance, October 29, 1906.

Sec. 458. TABLE OF STAIRWAYS FOR CLASS VII. BUILDINGS.
AGGREGATE WIDTH OF STAIRWAYS.

—SQUARE FEET OF—					
Building	1st, 2d, 3d, 4th.	5th, 6th, 7th, 8th.	9th, 10th, 11th, 12th.	13th, 14th, 15th, 16th.	
Area.	Story or Stories.	Story or Stories.	Story or Stories.	Story or Stories.	
25,000	30 feet	27 feet	24 feet	21 feet	6 stairways
20,000	25 feet	22 ft. 6 in.	20 feet	17 ft. 6 in.	5 stairways
15,000	20 feet	18 feet	16 feet	14 feet	4 stairways
14,000	19 feet	17 feet	15 feet	13 feet	4 stairways
13,000	18 feet	16 feet	14 feet	12 feet	4 stairways
12,000	17 feet	15 feet	13 feet	12 feet	4 stairways
11,000	16 feet	14 feet	12 feet	12 feet	4 stairways
10,000	15 feet	13 ft. 6 in.	12 feet	10 ft. 6 in.	3 stairways
9,000	14 feet	12 ft. 6 in.	11 feet	9 ft. 6 in.	3 stairways
8,000	13 feet	11 ft. 6 in.	10 feet	9 feet	3 stairways
7,000	12 feet	10 ft. 6 in.	9 feet	9 feet	3 stairways
6,000	11 feet	9 ft. 6 in.	9 feet	9 feet	3 stairways
5,000	10 feet	9 feet	8 feet	7 feet	2 stairways
4,000	9 feet	8 feet	7 feet	6 feet	2 stairways
3,000	8 feet	7 feet	6 feet	6 feet	2 stairways
2,000 and less	7 feet	6 feet	6 feet	6 feet	2 stairways

Whenever any building of fireproof construction used wholly or in part for the purposes of Class VII., shall adjoin or be attached to a fireproof building, used by the same occupant, and having in its required intervening fire wall one or more openings, fitted with fire doors, on each side of the fire wall, having self-closing device thereon, as approved by the Building Department, then every such opening shall, for all purposes, be held to be equivalent to and take the place of and be regarded as a stairway, built and enclosed in the manner described in the following section (459). But in no case shall there be less than one stairway in any such building.

As amended by ordinance, October 29, 1906.

Sec. 459. (Stairs.—Fireproof Interior.)—Where an interior stairway and its stair hall of a building used wholly or in part for the purposes of Class VII. are inclosed in all stories of the building by fireproof partitions built as described in Section 533 of this chapter for fireproof construction, and where the stairways and landings are built as described in Section 534 of this chapter for fireproof construction, and where the doors, frames, sashes and casings and the glazed portions thereof are built as described in Section 525 of this chapter for fireproof construction, then such stairway, if not less than five feet in width from first floor to the topmost floor, shall be considered as the equivalent of two open stairways, but in no case shall there be less than two stairways in any such building.

Sec. 460. (Stories.—Where Stories Above Twelfth Are Used for Class VII. Purposes.)—Where stories above the twelfth story are used for the purposes of Class VII. as hereinbefore described for employes' locker rooms, then the stairways from the first to the topmost floor shall be built and inclosed as described in the preceding section, but the stairways shall be in number and in their aggregate width as required in the table of stairways set forth in Section 458 of this chapter.

Sec. 461. (Stairs.—Halls.—Passageways and Aisles.—Signs and Lights.)—The stair halls, passageways or stair aisles shall be unobstructed and shall be as wide as the stairs, and not less than four feet wide in any place in the clear.

The exit door or doors between floors and stair halls shall be as wide as the stairway to which they afford access, and for each elevator opening into such a stair hall the doors to floors shall be increased to two feet in width.

The stairways and stair halls of any building used wholly or in part for the purposes of Class VII. shall be illuminated by gas or electric light, and the gas piping and the electric wiring shall be accomplished by piping and circuits separated and distinct from the general illuminating piping and circuits of the premises. Each stair light shall have a red glass inclosure.

At the bottom of each such stairway there shall be an illuminating red glass sign with the number of the story in which it is situated inscribed thereon in letters not less than six inches high.

Sec. 462. (Aisles in Class VII. Buildings.)—In buildings used wholly or in part for the purposes of Class VII, there shall be aisles in such portions of the building as are used for such purposes, connecting the stairways and the elevators directly with the street or alley doors, and such aisles shall be termed "main aisles." Such main aisles shall have a clear width equal to the width of the stairways connecting therewith, and for each elevator connecting with such an aisle there shall be an additional width of six inches, and no such main aisle shall be less than five feet wide in the clear between the counters in any department store or between the fixed seats therein. One-third the width of any basement stairway shall be added to the width of the main aisle connecting with such stairway.

If there is a column in any such aisle, then the width of the aisle shall be increased by the width of such column.

If there is a counter or counters or settee, or any case or other obstruction, in an aisle, then that part of the aisle on each side of such counter, settee or case or other obstruction shall be considered as a separate aisle. No aisle other than a main aisle shall be less than three feet in width.

Sec. 463. (Exit Signs and Lights.)—All exits in buildings used wholly or in part for the purposes of Class VII, shall be clearly indicated by illuminated red signs with the word "EXIT" thereon in letters not less than six inches high. At the bottom of each stairway on the street level floor there shall be similar signs indicating the direction of the nearest exit to a street or alley.

Fire escape doors or windows shall be indicated by illuminated red signs with the words "FIRE ESCAPE" thereon in letters not less than six inches high.

Sec. 464. (Doors at Street Level.—Revolving Doors.)—The clear width of the exit openings shall be computed in the same manner as that provided in this article for main aisles, and no door openings shall be less than five feet wide, and all doors shall swing outward. Revolving doors shall not be considered as exits, *unless the revolving wings of said revolving doors are so arranged that by the application of a force slightly more than necessary to revolve said doors and which one person of ordinary strength is capable of exerting, all the wings of said doors fold flat on each other and in an outward direction, and unless each side, or the half circles of such revolving doors, are hinged and fastened so as to likewise swing backwards on application of force slightly beyond the normal, and which will permit of exit space for two ordinary persons on either side of the collapsed wings of said revolving doors and their inclosing half circles.*

As amended by ordinance March 30, 1906, by addition of the part in italics.

Sec. 465. (Doors in Dividing Walls.)—Door openings may be built in dividing walls of such buildings, provided, however, that such door openings shall be provided with fireproof doors built as described in Section 260 of this chapter, and that each door shall have an efficient closing device, automatic in operation in the event of a fire, in close proximity to such door and on each side of such opening.

Each such opening shall have exit signs and lights as provided for street doors and exits in Section 463 of this chapter. There shall be aisles not less than five feet in width connecting with such doors from the main aisles, and in no case shall any such door be of less width than the aisle directly connecting therewith.

Doors and Windows.—When Required to Be Closed.—Fire Resisting Glass.—See Section 632.

Sec. 466. (Floors.—Strength Of.—Allowance for Live Loads.)—Every structural part of every building used wholly or in part for the purposes of Class VII, shall safely support, in addition to the weight of floor construction, partitions and permanent mechanisms that may be set upon the same, a live load of not less than one hundred pounds per square foot of floor area, and the construction shall be calculated according to the safe unit stresses elsewhere defined in this chapter. Every part of any such building which is subjected to a live load of more than one hundred pounds per square foot of floor shall be of sufficient strength in the parts which support such load to safely support the load imposed, calculated according to the safe allowable unit stresses elsewhere defined in this chapter.

Sec. 467. (Fire Escapes in Class VII. Buildings.)—Every such building more than two stories in height shall have two stairway fire escapes. Such stairway fire escapes shall each be not less than thirty-six inches wide between centers of hand rails. Such stairway fire escapes shall be at opposite ends of the building or as far apart from each other as practicable.

Sec. 468. (Passageways.—Fireproof.)—Where stairway fire escapes do not extend to the ground level they shall have a counterbalanced stairway to the ground from a platform not more than twenty feet above the ground level.

Fire escapes in inclosed courts shall have open, unobstructed fireproof passageways leading directly to a street or an alley.

Sec. 469. (Fire Escapes.—Windows and Railings On.—Doors Opening On.)—All windows and doors which are passed by a fire escape of any kind, and all windows and doors opening on fire escape platforms or landing shall have fireproof frames glazed with fire-resisting glass.

Each fire escape platform shall have at least one window on each floor in any such building opening thereon.

Each such window shall be indicated by signs and lights as required in Section 463 of this chapter for exits.

Where window sills at fire escape exits are more than two feet above the floor, one or more steps not less than three feet wide shall be provided, with risers not to exceed twelve inches high and treads not less than eight inches wide.

The railings on stairway fire escapes and the railings around fire escape platforms shall have iron guards in addition to the iron hand rails; such guards shall be not less than four feet high measuring from the outer corner of the tread or from the platform; such guards shall have a mesh or openings not over two and one-half inches square, and the metal strands in such guards shall have a cross section of not less than one-eighth of an inch in diameter.

Sec. 470 (Fire Drill of Employees.)—It shall be the duty of every person or corporation maintaining or in possession, charge or control of any building used wholly or in part for the purposes of Class VII, to designate certain adult male employees in such building (the number of which employees shall be prescribed by the Fire Marshal), who shall be regularly and throughout the entire time such building is open to the public employed in such building, and who shall be physically and mentally able to perform the duties which shall be required of them in case of fire occurring in any such building. Such employees shall at least once in each month, when directed by the Fire Marshal or any authorized member of the Fire Department, take part in a fire drill conducted by the Fire Marshal, or any authorized member of the Fire Department, in the use of all apparatus for the prevention and extinguishing of fire in such building, whenever the Fire Marshal shall deem such drill necessary or advisable. Such person or corporation shall pay to the city the proportion of the regular salary of any employee of the Fire Department who shall be employed in drilling and examining the employees of any such building, based upon the time of such employment, and the Fire Marshal shall render bills monthly for such services.

Sec. 471. (Standpipes.—Pumps.—Axes, Etc.)—Amended by ordinance March 19, 1906, to read as follows:

(1) In every building over one hundred (100) feet in height not provided with a three (3) inch or larger inside standpipe; in all buildings hereafter constructed of a greater height than seventy-five (75) feet (except buildings used for theater purposes, as herein elsewhere provided for); in all buildings used for hospital purposes of a greater height than three (3) stories with accommodations for at least twenty (20) patients; and in all buildings of a greater height than five (5) stories now or hereafter used for hotel or public lodging house purposes there shall be constructed one (1) or more four (4) inch standpipes, which shall extend from basement to roof, and which shall be connected at street or alley side of building with two-way Siamese connection for use of fire department, and which shall be provided with one hose connection, with fire department thread on the roof of said building, on each floor and in the basement thereof, with sufficient hose attached to reach any point thereof. The pattern, quality, installation and maintenance of such standpipe, hose and couplings shall be subject to the approval of the Fire Marshal.

(2) In any of the buildings herein referred to where approved sprinkler systems are installed and properly maintained, it shall not be necessary to install additional inside standpipe as above provided for.

(3) On each floor and in the basement of every building used for hotel, public lodging, hospital or school purposes, three or more stories in height, on each floor of all apartment buildings over three (3) stories in height the floors of which are divided into two or more apartments; on each floor of all office buildings, four (4) or more stories in height, the floors of which exceed two thousand (2,000) square feet in area; on each floor of all mercantile buildings three (3) or more stories in height, having a floor area of two thousand (2,000) or more square feet which is not equipped with approved wet sprinkler system, standpipe and hose, there shall be provided two (2) or more portable hand pumps, or chemical extinguishers, one or more fire axes, and one or more pike poles, all of which shall be installed and maintained subject to the approval and supervision of the Fire Marshal. As amended by ordinance March 19, 1906.

(4) The interior of all grain elevators and malt houses of a height of fifty (50) or more feet, which are not entirely fireproof, and which have a capacity of two hundred and fifty thousand (250,000) bushels or over, and the interior of all cold storage houses of a height of four (4) or more stories, which are not entirely fireproof and which have

a ground floor area of ten thousand (10,000) or more square feet, shall be equipped with either a dry or a wet sprinkler system, to each of which systems there shall be a feeder or riser pipe or pipes of not more than four (4) inches in diameter, leading from one or more Siamese steamer connections, all of which shall be installed and maintained subject to the approval of the Fire Marshal.

(5) Grain elevators which are equipped with Journal Fire Alarm Systems of the most approved pattern and which are left at all times in the most perfect working order, or grain elevators, malt houses and cold storage houses, which are now equipped with stand-pipes of approved pattern and hose with not less than two (2) inch connections, which have been installed in accordance with city ordinances and approved by the Fire Department, each floor of which is approved by said department as being at all times easily accessible to firemen, where fire extinguishers, water barrels and pails are distributed at intervals on all floors, on advice and instruction of the Chicago Underwriters' Association; where the necessary pump pressure is maintained; where some approved electric watch service and fire alarm system is maintained and watchmen are employed during nights, Sundays and holidays, pulling such stations not less frequently than once per hour, and which have outside Siamese connections and standpipes not less than two and one-half (2½) inches, shall be exempt from the provisions of this ordinance.

ARTICLE XI.

PROVISIONS RELATING SOLELY TO CLASS VIII.

In Class VIII. shall be included every building used exclusively for school purposes.

Sec. 472. (Buildings of Class VIII.—Construction Of.)—All buildings used wholly for the purposes of Class VIII. hereafter erected shall be constructed in accordance with the provisions of this chapter relating to Class VIII. as follows, viz.:

Such buildings having a seating capacity of less than four hundred, or which are not over two stories and basement in height, may be built of ordinary construction.

Such buildings having a greater seating capacity than four hundred and less than eight hundred, or which are not over three stories and basement in height, shall be built of slow burning or fireproof construction.

Such buildings having a greater seating capacity than eight hundred, and which are more than three stories and basement in height, shall be built entirely of fireproof construction.

New additions to existing buildings may be built; provided, however, that such new additions shall comply with the above requirements.

All alterations in existing buildings used wholly for the purposes of Class VIII., other than new additions thereto, intended to make them comply with the requirements of this chapter, may be executed in the same kinds of materials of construction at present employed in such buildings, unless otherwise distinctly provided herein.

Sec. 473. (Frame Buildings.—Portable.)—Portable frame buildings used wholly for the purposes of Class VIII., not larger than twenty-eight feet by thirty-six feet, and not over one story high, may be erected, provided the exterior walls and roof of same are covered with metal or incombustible material, and the interior woodwork painted with fireproof paint, approved by the Commissioner of Buildings. And provided, further, that the location of such buildings shall be approved by the Commissioner of Buildings. Such portable buildings shall not be located nearer than ten feet to any other building, and shall not be maintained on any one lot or block for a longer period than two years after the date of the issuance of the permit therefor without a new permit from the Commissioner of Buildings.

Doors and Windows.—(When Required to Be Closed.—Fire-Resisting Glass.)—See Section 632.

Sec. 474. (Walls.—Window Openings In.)—No wall of any building used wholly for the purposes of Class VIII. containing a window opening shall be nearer than five feet to any lot line of adjoining property (street and alley lines not included).

Sec. 475. (Walls.—Thickness Of.)—The following regulations shall govern the construction of buildings used wholly for the purposes of Class VIII.:

The thickness of surrounding walls and of all dividing walls carrying the load of floors or roof shall be as indicated in the following table, to-wit:

(Walls Around Stairs, Elevators and Shafts.—See Section 588.)

	Basement.	STORIES				
		1	2	3	4	5
		in.	in.	in.	in.	in.
One story	16	12				
Two stories	16	16	12			
Three stories	16	16	16	12		
Four stories	20	20	16	16	12	
Five stories	24	20	20	16	16	16

Buildings built of fireproof construction shall be excepted from the foregoing provisions of this section, but shall comply with the other provisions of this chapter governing such buildings.

Sec. 476. (**Loads.—Live.**)—The floors of buildings used wholly for the purposes of Class VIII. shall be designed and constructed so as to be capable of bearing in all their parts, in addition to the weight of floor construction, partitions, permanent fixtures and mechanisms that may be set upon same, a live load of seventy-five pounds per square foot.

Sec. 477. (**Stories.—Height Of.**)—No story above the basement shall be less than twelve feet in height in the clear.

Sec. 478. (**Floor Levels in Buildings of Fireproof Construction.**)—The following limitations of floor levels of auditoriums or assembly halls of such buildings shall be observed in all cases:

In buildings of fireproof construction.

Not to exceed two thousand seating capacity, not over ten feet above sidewalk level.

Not to exceed one thousand seating capacity, not over thirty feet above sidewalk level.

Not to exceed eight hundred seating capacity, not over fifty feet above sidewalk level.

Not to exceed five hundred seating capacity, in any story; provided, however, that there shall be at least two separate and distinct stairways from the floor in which such auditorium or assembly hall is located to the ground, each of which shall not be less than four feet wide in the clear.

Sec. 479. (**Floor Levels.—In Buildings Having Stairs and Corridors of Fireproof Construction.**)

Not to exceed one thousand five hundred seating capacity, not over ten feet above sidewalk level.

Not to exceed one thousand seating capacity, not over twenty-five feet above sidewalk level.

Not to exceed eight hundred seating capacity, not over forty-two feet above sidewalk level.

Not to exceed five hundred seating capacity, not over fifty feet above sidewalk level.

Not to exceed two hundred and fifty seating capacity, not over sixty feet above sidewalk level.

Sec. 480. (**Floor Levels in Buildings of Mill, Slow-Burning or Ordinary Construction.**)

Not to exceed one thousand seating capacity, not over ten feet above sidewalk level.

Not to exceed six hundred and fifty seating capacity, not over thirty feet above sidewalk level.

Not to exceed five hundred seating capacity, not over forty-five feet above sidewalk level.

Not to exceed two hundred seating capacity, not over sixty feet above sidewalk level.

Sec. 481. (**Floors.—Height Of, Measured from Sidewalk Level.**)—Heights shall be measured from sidewalk level at entrance of buildings to highest part of main floor of auditorium or assembly hall.

Sec. 482. (**Stairways.—Width Of.**)—Stairways in buildings used wholly for the purposes of Class VIII. shall be in width equivalent to fifteen inches for every hundred of seating capacity in such building, as measured by the aggregate seating capacity of the auditorium, assembly rooms and school rooms; provided, however, that the number of persons allowed in such buildings at any one time shall be limited by the width of stairways available as exits therefrom.

No stairway shall be less than four feet in the clear, except where more than two stairways lead down from any floor, in which case stairways three feet wide in the clear may be counted in the total width of stairways required.

Where two or more stairways are used, they shall be placed at opposite ends of the building, or as far apart as practicable, and all such buildings hereafter erected shall have at least two separate and distinct stairways from the ground floor to the top floor, and all existing buildings shall have two such separate and distinct stairways, or one stairway and one stair or sliding fire escape.

Sec. 483. (**Stairways.—Railings on Each Side.—Height of Landing.**)—All stairways shall have railings on each side thereof. No stairway shall ascend a greater height than thirteen feet six inches without a level landing, which, if its width is in the direction of the run of the stairs, shall be not less than four feet wide, or which, if at a turn of the stairs, shall be of not less width than the stairs, and no winder shall be permitted in any stairs.

Sec. 484. (**Stairways.—Fireproof.**)—In such buildings hereafter erected more than two stories and basement in height, the stairways and their enclosing walls shall be of fireproof construction.

Sec. 485. (**Corridors, Passageways, Hallways and Doors.—Width Of.**)—The width of corridors, passageways, hallways and doors shall be computed in the same manner as that herein provided for stairways; provided, however, that no corridor shall be anywhere less than five feet in width, and no door less than three feet in width, except where two or more doors, each two feet four inches or more in width, are grouped together.

Sec. 486. (**Doors to Open Outward.**)—All doors in such buildings shall open outward, and all entrance and exit doors shall be unlocked at all times when the building is occupied for school purposes, or open to the public.

Sec. 487. (**Doors.—Exits Covered with Metal.**)—All exit doors from assembly halls and class rooms to other parts of the building shall be covered with metal or other fireproof material, approved by the commissioner of buildings.

Sec. 488. (**Aisles.—Width Of.—Number of Seats in Auditorium.**)—Aisles in auditoriums and assembly halls in such buildings shall be in width equivalent to eighteen inches for every one hundred of seating capacity in such auditorium or assembly hall, but no such aisle shall be less than two feet six inches wide in its narrowest part. All groups of seats shall be so arranged that they shall have an aisle on each side, and not more than twelve seats in any one row shall be placed between aisles.

Sec. 489. (**Aisles in Class and Recitation Rooms.**)—Aisles in class rooms, recitation rooms and study rooms of such buildings shall be in width equivalent to eighteen inches for every one hundred permanent seats in any such room, but no main or cross aisle shall be less than two feet six inches wide in its narrowest part.

Sec. 490. (**Aisles and Passageways.—Kept Clear of Obstructions.**)—All aisles and passageways in such buildings shall be kept free from camp stools, chairs, sofas and other obstructions, and no person shall be allowed to stand in or occupy any of such aisles or passageways during any performance, service, exhibition, lecture, concert or any public assembly, nor shall there be any chairs, settees or camp stools in such aisles or corridors at such times or occasions.

Sec. 491. (**Emergency Exits for Auditoriums or Assembly Rooms.—Aggregate Width Of.**)—All auditoriums or assembly halls of such buildings having a seating capacity of eight hundred or more shall be provided with emergency exits. The aggregate width of such emergency exits which shall be provided for each floor, balcony or gallery of such auditorium or assembly hall shall be one-half of the width of the main exit. No emergency exit or stairway shall be less than three feet in width.

Sec. 492. (**Exits.—Signs.**)—All exits opening from auditoriums and assembly halls of such buildings shall have the word "EXIT," in letters at least six inches high, applied to the auditorium side of every such exit, and when such auditorium or assembly hall is used at night, a red light shall be kept burning over the word "EXIT" during the entire time such building is so used and until the pupils or audience have left the building.

Sec. 493. (**Lights in Buildings.**)—Every portion of any such building devoted to the uses or accommodation of the public and all outlets therefrom leading to the streets, including the open courts and corridors, stairways and exits, shall be well and properly lighted during the entire time such portion is in use, and shall remain lighted until all the pupils or the audience have left the premises. All gas or electric lights in the halls, corridors, lobbies, stairs and exits leading from the auditorium or assembly halls shall be controlled by a separate shut-off and shall be independent of all other lights in such building.

Sec. 494. (**Windows.**)—The total glass area of outside windows and skylights of each class room, recitation room or study room in such buildings shall be not less than one-ninth of the floor area of such room.

Sec. 495. (**Basement.**)—In every such building in which the lower or basement floor is below the surface of the ground surrounding such building, and is used in part or as a whole for heating or ventilating apparatus, such floor shall be considered the basement story of such building. Permanent class rooms in basements shall not be permitted.

Sec. 496. (**Fire Escapes.**)—Every building used for the purposes of Class VIII. of four or more stories in height shall be provided and equipped with one or more stairways or sliding fire escapes in such locations and numbers as shall be satisfactory to the Commissioner of Buildings.

Sec. 497. (**Fire Escapes to Be Examined.**)—It shall be the duty of the janitor of every such building, or such other employe or employes thereof as may be directed by the principal of such school to examine all fire escapes of such buildings from the topmost story to the ground, and to examine and operate all doors, windows and platforms leading to and from such fire escapes; and such inspection shall be made at least once each and every week that such building is used for school purposes, and a written report made of such inspection to the principal of such school, showing the time it was made and the condition of the fire escapes.

Such fire escapes shall be kept in good condition ready for immediate use at any and all times that such building is in use, and shall be kept free of snow and ice.

Sec. 498. (**Fire Drill.**)—The principal or other person in charge of the pupils in every such building shall establish and maintain a good and efficient fire drill, which shall be practiced at least twice every month during the time such building is used for school purposes.

A record shall be kept by the principal or other person in charge of the pupils of each fire drill held and of the time that elapses from the first fire signal until the last person is out of the building.

(**Walls.—Around Stairs, Elevators and Shafts.**)—See Section 588.

ARTICLE XII.

GENERAL PROVISIONS.

Fireproof Construction.

Sec. 499. (**Fireproof Construction.**)—In cases in which it is claimed that any equally good or more desirable mode or manner of construction, or material, or device for fireproofing, other than specified in this chapter, can be used in the erection or alteration of buildings, the Commissioner of Buildings, upon written application to him for a permit to use the same, shall have power to appoint a Board of Examiners, consisting of not less than three nor more than five members, each of whom shall have had at least ten years' experience in Chicago as an architect, engineer or builder, who shall take the usual oath of office. The said examiners shall adopt rules and specifications for examining and testing such mode or manner of construction, or material or device for fireproofing, and furnish a copy of the same to the applicant. And such specification shall provide for a comparative fire test of not less than four hours and for a period of at least two hours an average temperature of 2,000 degrees Fahrenheit shall be maintained. At the end of this test water shall be applied to the construction through a 1½-inch nozzle under 60 pounds pressure for five minutes. Hollow tile shall be used as a basis for comparison, and if the proposed material shall pass said test as well or better than hollow tile, it shall be approved as a fireproofing material. The said examiners shall thereupon notify such applicant to submit to such examination and make such tests in the presence of the said examiners, or a majority thereof, according to such rules and specifications. All expenses of such examiners, and of such examinations and tests, shall be paid by the applicant, and said examiners may require security therefor.

The said examiners shall, after such examination and tests, certify the results and their decision on the said application to the Commissioner of Buildings, who shall have power, in the event of the examination and tests being satisfactory, to grant a permit to the applicant in accordance with such decision of the said Board of Examiners.

A complete record of the proceedings and all acts and decisions of the said Board of Examiners shall be kept by the Commissioner of Buildings in his office.

The Commissioner of Buildings shall have the power to pass upon any question relative to the mode or manner of construction or materials to be used for fireproofing in the erection or alteration of any building or structure to make the same conform to the true intent and meaning of the several provisions of this chapter.

Sec. 500. (**Fireproof Construction.—Definition Of.**)—The term fireproof construction shall apply to all buildings in which all parts that carry weights or resist strains, and also all exterior walls and all interior walls and all interior partitions and all stairways and all elevator enclosures are made entirely of incombustible material, and in which all metallic structural members are protected against the effects of fire by coverings of a material which shall be entirely incombustible, and a slow heat conductor, and hereinafter termed "fireproof material." Reinforced concrete as defined in this ordinance shall be considered fireproof construction.

Sec. 501. (**Fireproof Material.**)—The materials which shall be considered as filling the conditions of fireproof covering are: First, burnt brick; second, tiles of burnt clay; third, approved cement concrete; fourth, terra cotta; fifth, approved cinder concrete.

Sec. 502. (**Concrete.—Approved Cement.**)—All approved cement concrete shall consist of a standard Portland cement, torpedo sand and crushed stone or gravel, or crushed blast furnace slag, or crushed burnt clay, the volumetric quantity of any one of these materials combined with the torpedo sand shall not exceed nine times the volume of the Portland cement. All of the ingredients of cement concrete shall be thoroughly worked and wet so as to cover each piece of stone or gravel or slag or burnt clay with moistened cement; and the cement and sand shall fill the voids between the coarse material of the cement concrete.

Cement concrete to be considered a fireproof material shall be cast and rammed in an unset condition against the metal.

Sec. 503. (**Machine or Hand Pressed Concrete.**)—Machine or hand pressed concrete bricks or blocks are not considered in this chapter as a fireproof material for the protection of metallic structural members.

Sec. 504. (**Brick, Burnt Clay, Tiles, Etc.—How Applied.**)—Brick, burnt clay, hollow tiles, porous clay, solid tiles and terra cotta shall be applied to the metal in a bed of mortar.

Sec. 505. (**Fireproof Covering.—Minimum Thickness Of.**)—The minimum thickness of fireproof covering on any metal shall be, if of hollow tile, constructed in such a manner that there shall be not less than one air space of at least three-fourths of an inch, by the width of the metal surface to be covered, within the clay covering; if of porous clay tiles, the covering shall be at least one and one-half inches thick. The minimum thickness of concrete covering any metal shall be two inches.

Sec. 506. (**Incombustible Materials.**)—A metal or fire-resisting glass of not less than one-quarter inch in thickness, or plastering, or plaster blocks, or stone or granite, or marble, or an improved cinder concrete, or one of the fireproof materials described herein shall be considered an incombustible material as called for by this chapter.

Sec. 507. (**Concrete.—Cinder.—Floor Filling.—Specifications For.**)—Whenever the use of a cinder concrete is permitted by this chapter, such cinder concrete shall be composed of the following named ingredients, in the proportion here described, to-wit: Five parts of clean, thoroughly burnt steam boiler cinders, no particle of which shall be larger than one (1) inch; three parts of clean grit sand, or of clean stone screenings, and one part of a Standard Portland cement; the working and wetting of these ingredients shall be done in the same manner as required for cement concrete in Section 502 of this chapter, and such a mixture of approved cinder concrete may be used only for floor filling.

Sec. 508. (**Fireproof Covering.—Measurements.**)—In every case the thickness of the covering specified in this chapter shall be measured from the extreme projection of the metal, unless otherwise provided herein.

Sec. 509. (**Skeleton Construction.**)—The term "skeleton construction" shall apply to all buildings wherein all external and internal loads and strains are transmitted from the top of the building to the foundations by a skeleton or framework of metal. In such metal framework the beams and girders shall be riveted to each other at their respective junction points. If columns made of rolled iron or steel are used, their different parts shall be riveted to each other, and the beams and girders resting upon them shall have riveted connections to unite them with the columns. If cast iron columns are used, each successive column shall be bolted to the one below it by at least four bolts not less than three-fourths of an inch in diameter, and the beams and girders shall be bolted to the columns. At each line of floor or roof beams, lateral connections between the ends of the beams and girders shall be made in such manner as to rigidly connect the beams and girders with each other in the direction of their length.

Sec. 510. (Walls.—Enclosing.)—If buildings are made fireproof entirely, and have skeleton construction so designed that their enclosing walls do not carry the weight of floors or roof, then their walls shall be not less than twelve inches in thickness; provided, such walls shall be thoroughly anchored to the iron skeleton, and whenever the weight of such walls rests upon beams or columns, such beams or columns shall be made strong enough in each story to carry the weight of wall resting upon them without reliance upon the walls below them. All walls shall be of fireproof or incombustible material.

Sec. 511. (Columns.—Exterior.)—All iron or steel used as a vertical supporting member of the external construction of any building exceeding sixty feet in height shall be protected as against the effects of external changes of temperature, and of fire, by a covering of fireproof material consisting of at least four inches of brick, or of four inches of concrete, or of four inches of burnt clay tiles, or of four inches of hollow terra cotta, or of a combination of any two of these materials, provided that their combined thickness is not less than four inches. The thickness of four inches shall be measured from the extreme projections of the metal of the column proper.

Where stone or other incombustible material is used for the exterior facing of a building, the distance between the back of the facing and the extreme projections of the metal of the column proper shall be at least four inches and this four-inch space shall be filled with one of the fireproof materials.

In all cases, the brick or burnt clay, tile or terra cotta, if used as a fireproof covering, shall be bedded in cement mortar close up to the iron or steel members, and all joints shall be made full and solid.

Sec. 512. (Fireproofing of Exterior Sides of Mullions.)—In buildings required by this chapter to be of fireproof construction, all vertical door or window mullions over eight inches wide shall be faced with incombustible material; horizontal transom bars over six inches wide shall be faced with a fireproof or with an incombustible material.

Sec. 513. (Spandril Beams, Girders, Lintel.)—The metal of the spandril beams or spandril girders, or lintels of exterior walls, which support a part of exterior walls, shall be covered in the same manner, and with the same material, as specified for the exterior columns in this chapter. The covering thickness shall be measured from the extreme projection of the metal in every case.

Sec. 514. (Fireproof Covering Independent.)—All covering of brick, concrete, burnt clay tiles, hollow terra cotta or of a combination of any two of these materials shall be applied to all of the structural members of the exterior of a fireproof building previously and independently of the application of the architectural facing of such fireproof building with an incombustible or fireproof material.

Sec. 515. (Iron or Steel Plates for Support of Wall.)—If iron or steel plates or angles are used in each story for the support of the facings of the walls within such story, such plates or angles shall be of sufficient strength to carry the weight within the limits of fiber stress for iron and steel elsewhere specified in this chapter, the enveloping material for such story, and such plates or angles may extend to within two inches of the exterior of such covering.

Sec. 516. (Walls, Support and Fireproofing Of.)—Where skeleton construction is used for the whole or part of a building, the enveloping material and the walls shall be independently supported on the skeleton frame for each individual story.

Sec. 517. (Terra Cotta.)—If terra cotta or other hollow blocks are used, as fireproof covering, they shall be backed up with brick or hollow tile or concrete; whichever is used shall be, however, of such dimensions and laid up in such a manner that the backing will be built into the cavities of the facing so as to secure perfect bond between the facing and its backing.

Sec. 518. (Coping.)—The upper surfaces of all breaks or offsets in external coverings and fillings and walls, as well as the tops of walls, shall be covered with stone, terra cotta, metal, concrete or fire clay copings set in cement mortar. Copings of all kinds which do not have lapped joints shall be pointed with mortar composed of one part of standard Portland cement and two parts of torpedó sand.

Sec. 519. (Columns.—Interior.)—The covering of interior columns shall be one or more of the fireproof materials herein described.

If such covering shall be of brick or concrete it shall be not less than four inches thick; if of burnt clay tiles such covering shall be in two consecutive layers, each not less than two and one-half inches thick, with one air space; if of porous clay solid tiles it shall consist of at least two layers not less than two inches thick each, or if constituted of a combination of any two of these materials, one-half of the total thickness required for each of the materials shall be applied, of each of such materials. Whether hollow tile, porous tile or terra cotta is used, the two consecutive layers shall be so applied that neither the vertical nor the horizontal joints in the same shall be opposite each other, and each course shall be so anchored and bonded within itself as to form an independent and stable structure.

In all cases, the brick or hollow tile, solid tiles or terra cotta shall be bedded in cement mortar close up to the iron or steel member, and all joints shall be made full and solid.

In the case of columns having an "H" shaped cross section or of columns having any other cross section, with channels or chases open from base plates to cap plates on one or more sides of the columns, then the thickness of the fireproof covering may be reduced to three inches, measuring in the direction in which the flange or flanges project, and provided that the thin edge in the projecting flange or arms of the cross sections does not exceed three-quarters of an inch in thickness. The thickness of the fireproof covering on all surfaces measuring more than three-quarters of an inch wide and measuring in a direction perpendicular to such surfaces shall be not less than that specified for interior columns in the beginning of this section, and all spaces, including channels or chases between the fireproof covering and the metal of the column, shall be filled with a solid fireproof material. Lattice or other open columns shall be completely filled with approved cement concrete.

Sec. 520. (Foundations.—Steel In.—Concrete Around Bottom of Columns.)—If steel or iron in any form is used as part of a foundation, it shall be thoroughly imbedded in a concrete, the ingredients of which shall be such that, after proper ramming, the interior of the mass will be free from cavities. The steel or iron shall be entirely enveloped in approved cement concrete, and around the exposed external metal surfaces of such foundation there shall be a covering of approved cement concrete not less than four inches thick.

After the bases or base plates and columns have been set in place, both shall be protected from the effects of moisture by a covering of approved cement concrete applied direct to the metal in an unset state, measuring not less than two and one-half inches thick from the extreme projection of the metal, filled solid into all spaces, and forming a continuous concrete mass from the grillage or other foundations to an elevation six feet above the floor level nearest the column base plate or column stool.

Sec. 521 (Columns.—Wiring Clay Tiles On.)—Burnt clay tile column covering shall be secured by winding wire around the columns after the tile has all been set around such columns. The wire shall be securely wound around the tile in such manner that every tile is crossed at least once by a wire. If iron wire is used it shall be galvanized, and no wire used shall be less than No. 12 gauge.

Sec. 522. (Fireproofing.—Protective Covering For.)—In places where there is trucking or wheeling or other handling of packages of any kind, the lower five feet of the fireproofing of such columns shall be encased in a protective covering either of iron or oak plank, which covering shall be kept continually in good repair.

Sec. 523. (Pipes Inclosed by Covering.)—Pipes shall not be inclosed in the fireproofing of columns or in the fireproofing of other structural members of any fireproof building, provided, however, gas or electric light conduits not exceeding one inch inside diameter may be inserted in the outer two inches of the fireproof of such structural member.

Sec. 524. (Shafts, Etc.)—In cases where a pipe, conduit, dumb waiter, cable, wire, conveyor, belt or any combination thereof passes from one story to another story through an open hatch or floor opening, a shaft or enclosure of fireproof material shall be built from floor to floor around such hatch or floor opening, in each story above and below such hatch or floor opening in the same manner as described for fireproof partitions in this chapter. The area of space thus inclosed shall not exceed the area of the hatch or floor opening by more than one hundred per centum.

In no case shall any wood be used in the construction or support or fittings of such shaft as described above. If such holes in floors as described above in this section are not enclosed by such fireproof enclosures, then the open spaces in each floor opening not occupied by pipes, conduits, cables, wires, conveyors, belts or any combination thereof, shall be filled solid with fireproof material not less than eight inches thick.

Sec. 525. (Shafts, Partitions Around, Plastering of Shafts, Doors and Windows.)—All burnt clay or terra cotta partitions or walls around shafts having openings in floors shall be plastered on the outside and plastered or pointed on the inside.

All doors, frames, sashes, casings and windows in partitions or walls around floor openings, or around stair shafts or elevator shafts, shall be built of incombustible material. The supports of such doors, frames, sashes, casings and windows shall also be of incombustible material; in the case of doors, such supports shall be of rolled structural metal extending from floor to ceiling and secured to both. Where there are brick walls of twelve inches or more in thickness, the supports need not extend to ceiling as above specified. All glass used in connection with such partitions or walls shall be fire resisting.

Sheet metal work pressed over asbestos paper and wood may be used for the doors, frames, sashes and casings, and for openings in such partitions, except for elevator doors in shafts and where the provisions of this chapter require all metal doors.

Sec. 526. (Beams and Girders, Coverings Of.)—The beams and girders of the interior structural parts of a building shall be covered by one of the fireproof materials, so applied as to be supported entirely by the beam or girder protected, and shall be held in place by the support of the flanges of such beams or girders and by the cement mortar used in setting. If metal binding or metal anchors are used as fastenings of such fireproof covering, such metal binding or such metal anchor shall be protected by not less than one-half inch of fireproof covering.

If the covering is of brick it shall be not less than four inches thick; if of hollow tiles or if of solid porous tiles, or if of terra cotta, each of such tiles shall be not less than one and one-half inches thick, applied to the metal in a bed of cement mortar; hollow tiles shall be constructed in such a manner that there shall be one air space of at least three-fourths of an inch by the width of the metal surface to be covered within such clay coverings; the minimum thickness of concrete on the bottom and sides of metal shall be two inches.

The top of all girders and beams shall be protected with two inches of brick or one and one-fourth inches of burnt clay, or two inches of approved cement concrete, or three inches of approved cinder concrete. The brick or burnt clay shall be bedded solid on the metal in cement mortar.

In all cases of beams or girders, in roofs or floors, no matter what the material or form of the floor arch used, the protection of the bottom flanges of the beams and girders and so much of the web of the same as is not covered by the arches shall be made as hereinbefore specified for the covering of beams and girders. In every case the thickness of the covering shall be measured from the extreme projection of the metal, and the entire space or spaces between the covering and the metal shall be filled solid with one of the fireproof materials excepting the air spaces in hollow tile.

Sec. 527. (Girders and Trusses.)—All girders or trusses, when supporting loads from more than one story, shall be fireproofed with two thicknesses of fireproof material or a combination of two fireproof materials, as required for exterior columns in Section 511 of this chapter, and each covering of fireproof material shall be bedded solid in cement mortar.

All other girders or trusses supporting only a ceiling or roof shall be covered with a fireproof covering as specified for beams and girders in Section 526 of this chapter.

Sec. 528. (Cut-Out Boxes, Chases, Etc.)—No electric service cut-out box, switch box, cabinet, chase or any other recess, shall encroach on the minimum thickness required for any fireproof covering on structural metal, except as provided in Section 523 of this chapter. If the depth of any cut-out box, switch box, cabinet, or chase, or of any other recess, is to be concealed or partially concealed, then the thickness of the fireproof covering shall be increased correspondingly.

Sec. 529. (Floor, Construction Of.—Hollow Tile Flooring.)—Brick, hollow, tile, porous terra cotta, or approved cement concrete, or approved cinder concrete, shall be used for the construction of floors and roofs of fireproof buildings. Flat arch hollow tile, or flat arch porous clay tile floor arches shall have a height of at least one and one-half inch for each foot of span.

Hollow tile flat arch floor construction having a thickness of only one and one-half inch for each foot of span shall be used only for the minimum floor loads, and the area of burnt clay in the flanges and ribs, and webs of the hollow burnt clay tiles shall be proportioned to the safe value of resistance to compression of the materials used in the most stressed areas of the burnt clay.

Sec. 530. (Segmental Arches.)—Segmental arches shall have a rise of at least one inch for each foot of span of arch.

The least thickness of a hollow tile or porous terra cotta segmental arch shall be one-half of an inch per foot of span, but no such hollow tile or terra cotta arch shall be of a thickness less than five inches.

Both flat and segmental arches shall be so constructed that the joints of the same radiate from a common center and there shall be a cross rib for every four inches, or fractional part thereof, in height in each tile block. The skew back of the arches shall be carefully fitted to the beams supporting them, and in addition to the cross ribs there shall also be additional diagonal reinforcing ribs in the skew back. Such arches, whether flat or curved, shall have their beds well filled with cement mortar, and the centers shall not be struck until the mortar has set.

Burnt clay skew backs shall be molded in such a manner as to support the burnt clay covering on the under sides of beams or girders.

Sec. 531. (Floors, Wood Surfacing and Nailing Strips.)—Wood floor surfacing and wooden nailing strips for such wood floor surfacing may be used in fireproof buildings.

Where wood flooring is used in a fireproof building, the space immediately under such wood flooring, and between the wood nailing strips and under such wood nailing strips, shall be filled with a cement or a cinder concrete tamped into place in an unset state, or such other incombustible material as shall be approved by the Commissioner of Buildings.

Sec. 532. (Partitions in Fireproof Buildings.)—The partitions around stairs, stair halls, shafts, elevators or public lavatories shall be fireproof partitions, as described in Section 533 of this chapter; all other partitions in fireproof buildings shall be incombustible partitions. Where blocks are used for building partitions or as enclosing walls the joints shall be well filled with mortar.

The partitions shall be wedged tight between floors and ceilings with incombustible wedges.

Sec. 533. (Partitions, Fireproof.—Incombustible.)—Only fireproof material shall be used for fireproof partitions; if of brick, they shall be not less than four inches thick, and if of partition blocks, not less than three inches thick. If fireproof partitions are of reinforced concrete they shall be not less than two inches thick.

All fireproof partitions shall be supported directly by the steel construction, or by the fireproof floor arches, or stone concrete, or brick. No cinder concrete or wood flooring shall intervene between any such partition and its support.

All doors, windows, sashes, frames, casings and glass in fireproof partitions shall be built as required in Section 525 of this chapter.

Only fireproof or incombustible material shall be used in the construction of incombustible partitions, excepting that frames, casings, doors, sash and the rough carpenter work required for the proper fastenings of such frames, casings, doors or sash, may be of wood, and that ordinary glass may be used in doors and partition windows.

Sec. 534. (Stairs, Landings.)—Stairs in fireproof buildings shall be built of approved cement concrete, reinforced concrete, stone or with metal supports, metal strings, metal treads, metal platforms, or a combination of one or more of such materials.

If reinforced concrete is used in the construction of any stairs in a fireproof building, such stairs shall be designed according to the provisions of the sections applying to reinforced concrete.

Stairs shall carry a live load of not less than one hundred pounds per square foot on treads and landings, and every part of a stair shall be so designed that the safe limit of fiber stress is not exceeded.

The hand rails of such stairways may be of wood, all other material in such stairways in fireproof buildings shall be "fireproofed," or "incombustible" material, except cinder concrete.

If stairs are constructed of solid concrete, having the tread and riser in one piece, then there shall be not less than forty-five square inches of concrete in the cross section of such combined tread and riser, and such stairs shall have reinforced concrete or metal outer strings.

If stone treads or platforms are used they shall have a metal sub-tread, or sub-platform, of the same weight as if the metal alone were used.

If platforms have a floor arch sub-construction as described in Section 529 of this chapter, then the metal sub-platform may be omitted.

Sec. 535. (Painting.)—All structural metal which is used in a fireproof building, or which is used in any foundation, or which is used in reinforced concrete work, shall be clean and free of rust, or scale at the time of the enclosure or covering of such metal. All metal which is not to be fireproofed shall have two coats of first-class metal protecting paint.

Sec. 536. (Rivets, Machine Driven.)—All structural steel and iron work shall be so riveted that the distance from the center of the rivet hole to the edge of the materials shall be not less than:

$\frac{5}{8}$ inch for $\frac{1}{2}$ -inch rivets.

$\frac{7}{8}$ inch for $\frac{5}{8}$ -inch rivets.

$1\frac{1}{8}$ inches for $\frac{3}{4}$ -inch rivets.

$1\frac{3}{8}$ inches for $\frac{7}{8}$ -inch rivets.

Wherever possible, however, the distance from the rivet hole to the edge of the material shall be equal to two diameters of such rivet hole. All rivets, wherever practicable, shall be machine driven; the rivets in connection shall be proportioned and placed to suit the stresses, and the pitch of rivets shall never be less

than three diameters of the rivets nor more than six inches. All holes shall be punched accurately, so that upon assembling a cold rivet will enter the hole without straining the material by drifting. The rivets shall fill the holes completely, and, whenever necessary, gussets shall be provided of thickness and size to accommodate the number of rivets necessary to make a connection.

Sec. 537. (Truss Designs to Be Submitted.)—When steel or iron trusses are used the trusses shall be of such design that the stress in each member may be calculated and all trusses when placed shall be held rigidly in position by an efficient system of lateral and sway bracing, and any member of a truss subjected to transverse stress in addition to direct tension or compression shall have the stress causing such strain added to the direct stresses coming on the member, and the total stresses shall in no case exceed the stresses provided for in Section 594 of this chapter.

Sec. 538. (Trusses to Be Inspected.)—On all buildings in process of construction, where the plans call for the use of trusses, or iron and steel structural work, the erection of such iron and steel structural work and of such trusses shall be inspected thoroughly by an inspector from the Building Department of the city, and such inspector shall be a man well versed in the design and construction of structural steel and iron work, and it shall be the duty of such inspector to see that the provisions of this chapter are strictly complied with, and such inspector shall have the authority to compel the contractors and builders to use a sufficient amount of temporary bracing or guys necessary to insure the safety of the work during its erection and to compel such contractors and builders to keep all derricks, tackles and hoisting appliances used in such work in a safe condition and to enforce all the provisions of this chapter.

Sec. 539. (Bolts to Be Turned and Holes to Be Reamed.)—Wherever it is found impossible to rivet connections as herein described and such connections are bolted, the bolts shall be turned and the holes reamed so as to get a perfect fit.

All structural members which are temporarily bolted together shall be well bolted in every alternate hole.

Sec. 540. (Fireproof Buildings, Height Of.)—The height of a fireproof building shall be measured from the average inside grade line of the street frontage of the building to the top of the highest point of the external bearing walls. Roof houses for elevators, or tanks, or skylights, or stairs, or scuttles may be built above the height of the main roof, and no building shall be erected in the city of greater height than two hundred and sixty feet.

Sec. 541. (Roofs, Rise of Roof Above Limit of Height.)—In the case of buildings which are entirely fireproof in their construction, and of which the roof is also entirely of fireproof construction, the roof may rise above the limit of height of wall fixed by this chapter for such buildings at a slope not to exceed thirty degrees with the horizon, and to a height not exceeding twenty feet above such limitation of the height of such wall. The space enclosed by such roof above the limitation of the height of such wall may be used as an enclosure for pipes, ventilating or elevator machinery or for ventilating ducts, but it shall not be lawful to use such space for purposes of storage, business or residence.

Sec. 542. (Sheet Metal Work, Support Of.)—Wood shall not be used as the support of any sheet metal work or of any gutter or cornice of a building more than one hundred feet in height.

Sec. 543. (Reinforced Concrete.—Regulations in Regard to the Use of.)—The term "reinforced concrete," as used in this chapter, shall be understood to mean an approved concrete mixture reinforced by steel of any shape, so combined that the steel will take up the tensional stresses and assist in the resistance to shear.

Sec. 544. (Stress.)—Reinforced concrete construction shall be of such nature that the stresses can be calculated according to the accepted formulas of modern concrete engineering practice.

Sec. 545. (Permission to Erect.)—Before permission to erect any reinforced concrete structure is issued, complete drawings and specifications shall be filed with the Commissioner of Buildings, showing all details of the construction, the size and position of all reinforcing rods, stirrups, etc., and giving the composition of the concrete.

Sec. 546. (Concrete.—Mixing Of.—Method of Testing.)—The concrete shall be mixed in the proportions of one of cement, three of sand and five of stone, gravel or slag. The proportions shall be such that the resistance of the concrete to crushing shall not be less than two thousand pounds per square inch after hardening for twenty-eight days. The tests to determine this value shall be made by a competent engineer under the direction of the Commissioner of Buildings. The concrete used in reinforced concrete construction shall be what is usually known as a wet mixture.

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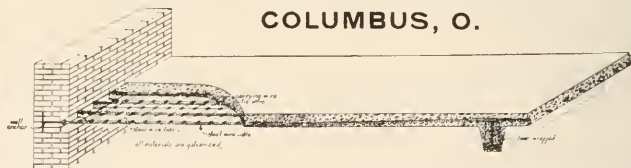
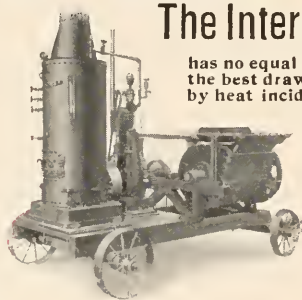
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Sec. 547. (Cements.—Method of Testing.)—Only high-grade Portland cements shall be used in reinforced concrete construction. Such cements, when tested neat, shall, after one day in air, develop a tensile strength of at least two hundred pounds per square inch; and after one day in air and six days in water shall develop a tensile strength of at least five hundred pounds per square inch; and after one day in air and twenty-seven days in water shall develop a tensile strength of at least six hundred pounds per square inch. Other tests as to fineness, constancy of volume, etc., made in accordance with the standard method prescribed by the American Society of Civil Engineers' Committee, may from time to time be prescribed by the Commissioner of Buildings.

Sec. 548. (Sand.—Stone, Crushed Slag or Gravel.—Steel.)—The sand to be used in such concrete shall be clean, sharp torpedo sand, free from loam or dirt.

The stone used in such concrete shall be clean, crushed stone or gravel, or crushed blast furnace slag of a size that will pass through a three-quarter-inch ring. The stone shall be fresh broken and the gravel shall be thoroughly washed.

The steel used shall be calculated according to its elastic limit; for moving or vibrating loads a steel of a lower elastic limit than is used for quiescent loads shall be used.

Sec. 549. (Reinforcing.—Method Of.)—All reinforcing steel shall be completely enclosed by the concrete, and such steel shall nowhere be nearer to the surface of the concrete than the diameter of such reinforcing steel bar, or rod or other shape. The steel in beams or girders shall be so disposed that there shall be not less than one and one-half times the thickness of the steel in concrete between the steel, and where more than two bars are used the bars shall be placed in two or more planes.

Reinforced concrete shall be so designed that the stresses in the concrete and the steel shall not exceed the following limits: Extreme fiber stress on concrete in compression, five hundred pounds per square inch; shearing stress in concrete, seventy-five pounds per square inch; concrete in direct compression, three hundred and fifty pounds per square inch; tensile stress in steel, one-third of the elastic limit; shearing stress in steel, ten thousand pounds per square inch.

The adhesion of concrete to steel shall be assumed to be seventy-five pounds per square inch of surface where bars are three-quarters of an inch or less in diameter and proportionately less for bars of a diameter greater than three-quarters of an inch.

The ratio of the moduli of elasticity of concrete and steel shall be taken as one to twelve.

The following assumption shall guide in the determination of the bending moments due to external forces: Beams and girders shall be considered as simply supported at the ends, no allowance being made for continuous construction over supports. Floor plates, when constructed continuous and when provided with reinforcement at top of plate over the supports, may be treated as continuous beams, the bending moment for uniformly distributed loads being taken at not less than $W. L.$ divided by eight; the bending moment may be taken at $W. L.$ divided by twenty in the case of square floor plates which are reinforced in both directions and supported on all sides. The floor plate to the extent of not more than five times the width of any beam or girder may be taken as part of that beam or girder in computing its moment of resistance.

The moment of resistance of any reinforced concrete construction under transverse loads shall be determined by formulas based on the following assumptions:

(a) The bond between the concrete and steel is sufficient to make the two materials act together as a homogeneous solid.

(b) The strain in any fiber is directly proportionate to the distance of that fiber from the neutral axis.

(c) The modulus of elasticity of the concrete remains constant within the limits of the working stresses fixed in this chapter.

From these assumptions it follows that the stress in any fiber is directly proportionate to the distance of that fiber from the neutral axis.

The tensile strength of the concrete shall not be considered.

Sec. 550. (Construction.—Reinforced Concrete.)—Reinforced concrete construction shall be designed so that the shearing stresses, both vertical and horizontal, developed in any part of the construction, shall not exceed the safe working strength of the concrete as fixed in this chapter, or a sufficient amount of steel shall be introduced in such a position that the deficiency in the resistance to shear is overcome.

When the safe limit of adhesion between the concrete and steel is exceeded, some provision shall be made for transmitting the strength of the steel to the concrete.

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Cement Basements and Walks

Reinforced Concrete

Sec. 551. (Columns.—Reinforced Concrete.)—Reinforced concrete may be used for columns when the ratio of length to the least side or diameter does not exceed twelve. The reinforcing rods shall be tied together at intervals of not more than the least side or diameter of the column, or spirally wound steel may be used.

When vertical reinforcing rods are used in columns, such rods shall have their ends milled normal to the longitudinal axis, and such rods shall have full perfect bearings at each joint, and such joints shall occur only at floors or other points of lateral support and a tight fitting sleeve shall be provided at all joints of vertical reinforcing rods.

Sec. 552. (Wind Pressure.)—In the case of buildings in which allowances must be made for wind pressure as provided in Section 603 of this chapter, the reinforcing rods of columns shall be connected and the milled end surfaces shall be brought together by threading the rods and by threaded sleeve nuts, or threaded turnbuckles, or methods equally effective and satisfactory to the Commissioner of Buildings.

Sec. 553. (Tests.—To Be Made by Contractor on Demand.)—The contractor shall be prepared to make load tests on any portion of a reinforced concrete construction within a reasonable time after erection, as often as may be required by the Commissioner of Buildings. Such tests shall show that the construction will sustain a load twice that for which it is designed, without any sign of failure, or in the case of beams, girders or floors, without deflecting more than one-seven-hundredths of the span.

Sec. 554. (Reinforced Concrete Walls.)—Buildings of Classes I., II., III., VI. and VII. having a complete skeleton construction of steel or of reinforced concrete construction or a combination of both, designed to safely resist all of the strains caused by the dead weights of the structure and of the live loads and of the wind pressure within the safe limits of stress provided in this chapter for each material used, may have walls of reinforced concrete six inches thick for the upper two stories and walls seven inches thick for the two stories next below the upper two stories, and walls eight inches thick for the stories next below the upper four stories, and walls nine inches thick for the stories next below the upper six stories, and so on downwards, increasing the thickness of the walls one inch for each two stories or part thereof. Provided, however, that such walls shall support only their own weight, and that such walls have steel rods three-quarters of an inch in diameter or of an equivalent area set vertically, and spaced not more than eighteen inches apart, and steel rods five-eighths of an inch in diameter or of an equivalent area set horizontally tied to the vertical rod at each intersection with these, and set not to exceed twenty-four inches apart; and provided that where the weight of the walls of each story is not transferred to the skeleton by spandril beams, the vertical reinforcement shall be increased in weight in an arithmetical ratio of twice as much steel in the two stories next below the upper two stories, and three times as much steel in the two stories next below the upper four stories, and so on downward. Vertical bars shall be spliced together by winding with iron wire. Horizontal bars shall be wired to the columns. Additional bars shall be set around openings, the verticals wired to the nearest horizontal bars and the horizontal bars at top and bottom of openings shall be wired to the nearest vertical bars.

The steel rods shall be combined with the concrete and placed where the combination will develop the greatest strength, and the rods shall be staggered or placed and secured to the steel or reinforced concrete structural skeleton of the building, so as to resist a pressure of fifty (50) pounds per square foot, either from the exterior or from the interior on each and every square foot of each wall panel.

Sec. 555. (Molded Hollow Concrete and Hollow Tile Block.)—Molded hollow concrete blocks or molded hollow vitrified clay building blocks of the full thickness of a ten-inch wall may be used wherever eight-inch walls are called for by this chapter, and such blocks may also be used wherever twelve-inch brick walls are called for in this chapter under frame cottages and in one and two story Class III. and Class VI. buildings.

ARTICLE XIII.

SLOW-BURNING CONSTRUCTION.

Sec. 556. (Slow-Burning Construction Defined.)—The term "slow-burning construction" shall apply to all buildings in which the structural members which carry the loads and strains which come upon the floors and roofs thereof are made wholly or in part of combustible material, but throughout which the structural metallic members shall be protected against injury from fire by coverings of incombustible, non-heat conducting material similar to those described under the head of "skeleton construction," except that plastering and metallic lath may be used as provided

herein. In the case of columns the metallic lath shall be fastened to metallic furrings and the plastering upon the same shall be of three coats of mortar. The lower five (5) feet of each column shall be protected as required for brick, concrete or tile covering in Section 522 of this chapter. A covering of three (3) coats of plastering on metallic laths shall be considered sufficient protection for the under side of joists and girders and a layer of mortar or other incombustible material at least one and one-half inches thick shall be applied on all floors and roof surfaces above the joists of the same.

Sec. 557. (**Posts, Partitions and Elevator Enclosures.**)—Where oak posts of greater sectional area than one hundred square inches are used, they need not be covered. All partitions and all elevator enclosures in buildings of this type shall be made entirely of incombustible material. The use of wood furring or of stud partitions shall not be allowed in buildings of this type.

Sec. 558. (**Stairs.—To Be Incombustible.**)—Where buildings are required by this chapter to be of "slow-burning construction," all stairs in such buildings shall be of incombustible material.

ARTICLE XIV.

MILL CONSTRUCTION.

Sec. 559. (**Mill Construction Defined.**)—The term "mill construction" shall apply to all buildings in which all the girders and joists supporting floors and roof have a sectional area of not less than seventy-two square inches, and above the joists of which there is laid a timber floor not less than three and three-fourths inches thick. Wooden posts used in buildings of this type shall not be of smaller sectional area than one hundred square inches.

Sec. 560. (**Fireproofing.**)—Partitions and elevator enclosures in buildings of this type shall be made entirely of incombustible material. If iron columns, girders or beams are used in buildings of this type, they shall be protected as specified in this chapter, but the wooden posts, girders and joists need not be protected by fireproof covering. The use of wood furring, wood laths or stud partitions shall not be permitted in buildings of this type.

Sec. 561. (**Stairs.—To Be Incombustible.**)—Where buildings are required by this chapter to be of "mill construction" all stairs in such buildings shall be of incombustible material.

Sec. 562. (**Concrete Construction.—Approved Cinder.**)—The term "approved cinder concrete construction" shall apply to all buildings in which all parts that carry weights or resist strains, all exterior walls, all interior walls, all interior partitions, all stairs and all elevator enclosures are made entirely of incombustible material, and in which all metallic structural members are protected against the effects of fire by approved cinder concrete proportioned, mixed, applied and secured as herein described. Approved cinder concrete construction may be used for all buildings in which fireproof construction is mandatory by this chapter, or where ordinary construction may be used.

Approved cinder concrete shall consist of a standard Portland cement, torpedo sand, and clean, thoroughly burnt steam boiler cinders, free from deleterious matter, no particle of which shall be larger than one inch.

Sec. 563. (**Cinders.—Quantity.**)—The volumetric quantity of the cinders combined with the torpedo sand shall not exceed the volume of the Portland cement by more than eight (8) times. All of the ingredients of approved cinder concrete shall be thoroughly worked and wet so as to cover each piece of cinder with moistened cement; and the cement and sand shall fill all of the voids between the cinders.

All approved cinder concrete shall be cast and rammed in an unset condition against the metal.

The minimum thickness of approved cinder concrete covering in structural metal shall be two (2) inches. In every case the thickness of the coverings shall be measured from the extreme projection of the structural metal unless otherwise provided in this chapter.

Sec. 564. (**Columns.—Approved Concrete.—Coverings.**)—The approved cinder concrete covering of the columns shall be not less than three (3) inches in thickness from the extreme projection of the metal, including the plastering, and in all cases the cinder concrete shall be rammed solid against the column metal, filling all channels and open spaces within the perimeter of the finished plaster column. Approved cinder concrete column covering shall have metal binders of No. 8 gauge wire imbedded in and around the columns for each sixteen (16) inches in height of the column, provided, however, that in buildings of approved cinder concrete construction the columns may be covered with one thickness of metal furring, metal lathing and not less than three coats of mortar.

In places where there is trucking or wheeling, or handling of packages of any kind, the lower five (5) feet of every column shall be incased in a protective covering such as is described in Section 522 of this chapter.

Sec. 565. (Beams and Girders.—Approved Cinder Concrete Construction.)—The beams and girders of a building built of approved cinder concrete construction shall be enclosed in approved cinder concrete which shall be not less than two (2) inches in thickness at any and all points of the structural metal work. The approved cinder concrete covering shall be reinforced with metal clips or wire binders, either or both of which shall not be more than sixteen (16) inches on centers in the direction of the length of the structural member.

The top of all girders or beams shall be protected with not less than two (2) inches of approved cinder concrete.

A floor or roof construction of approved cinder concrete may be used for any span between structural members that will carry the test loads required by this chapter for such floors and roofs.

Sec. 566. (Segmental Arches.)—Segmental arches shall be not less than three (3) inches in thickness at the crown.

Sec. 567. (Floors.—Flat Slab Construction.)—Flat slab floor construction shall be not less than four (4) inches in thickness for spans of eight (8) feet or less. Flat slab floor construction shall be not less than five (5) inches in thickness for spans between eight (8) and ten (10) feet.

Approved cinder concrete shall not be used as a floor or roof construction unless such approved cinder concrete is reinforced by steel or iron, and such reinforcement shall not weigh less than three-quarters of a pound per square foot of superficial surface.

All reinforcing steel shall be completely enclosed by the concrete.

Wood nailing strips for floor surfacing may be used in buildings of approved cinder concrete construction, provided, however, that such nailing strips shall be imbedded as described in Section 531 of this chapter.

Sec. 568. (Partitions.)—The partitions in buildings of approved cinder concrete construction shall be as described in Section 532 of this chapter for partitions in fireproof buildings, provided, however, that partitions may be built wholly of metal studding, metal lath and plaster, but no such partitions shall be of a less thickness than one and one-half (1½) inch.

The partitions around stairs, or stair halls, or shafts, or elevators, or public lavatories, shall be wedged tight between the structure of the floors and ceilings, or if such partitions are of plaster, the metal or metal studding shall be secured to the structure by clips, bolts or other metal fastening, and in no case shall any such partition be built on the wood flooring or wood nailing strips.

Sec. 569. (Walls.—Enclosing.)—The enclosing walls, the covering of exterior side of mullions, beams, girders, lintels, the enclosures of pipes, pipe shafts, the doors into shafts, windows into shafts, covering of girders, covering of trusses, cut-out boxes, chases, stairs, landings, painting, rivets, bolts, and all other items required in these sections on fireproof construction and in the sections on skeleton construction shall, in buildings of approved cinder concrete construction be designed or built or covered, or made of the material called for, or any one or a number of these requirements, as described in such sections describing the requirements of skeleton construction or of fireproof construction in this chapter, provided, however, that approved cinder concrete as described herein may be used for all protective covering of structural metal.

ARTICLE XV.

ORDINARY CONSTRUCTION.

Sec. 570. (Ordinary Construction Defined.)—The term "ordinary construction," as used in this chapter, means the ordinary system of construction in which timber and iron structural parts are not protected with fire resisting coverings.

ARTICLE XVI.

GENERAL CONSTRUCTION REQUIREMENTS.

Sec. 571. (Construction or Alteration of Buildings.)—Every building or structure, or part thereof, hereafter constructed, erected, altered, enlarged or changed anywhere within the city, shall be so constructed, erected, altered, enlarged or changed only in accordance with the provisions of this chapter.

Sec. 572. (Materials.)—Materials used in the construction of buildings of all classes shall conform to the following specifications:

Sec. 573. (Foundation Proportions.)—Foundations shall be proportioned to the actual average loads they will have to carry in the completed and occupied building.

Sec. 574. (Foundation Construction.)—Foundations shall be constructed of either of the following: Approved cement concrete, dimension or rubble stone, sewer or paving bricks or iron or steel or piles. If iron or steel is used the filling and the coating of the same shall be of Portland cement as provided in Section 583 of this chapter, piles shall be covered with grillage of timber, concrete or steel, or a combination of these. Where timber grillage or timber piles are used, the top of such grillage or such piles shall be at least one foot below city datum.

Sec. 575. (Foundation of New and Old Walls.)—In all cases where there is an increase in the thickness of walls, a new foundation shall be built in such manner as to carry jointly both the new and old walls, and the soil under such foundations shall not be loaded beyond the limits hereinbefore specified in this chapter. All foundations shall be protected against the effects of frost, and frozen cement mortar shall not be used in connection with building operations.

Sec. 576. (Foundations.—Pile Borings Required.—Safe Load Required.—Fiber Stress.)—Where pile foundations are used, auger borings of the soil shall first be made to determine the position of the underlying stratum of hard clay or rock, and the piles shall be made long enough to sustain the required load according to approved formulas for pile driving, and timber piles shall not be loaded more than twenty-five tons to each pile. The heads of the piles are to be protected against splitting while they are being driven, and after having been driven the piles are to be sawed off to a uniform level and covered with a grillage so proportioned that in the transmission of the load from the structure to the pile the extreme fiber stress of the grillage shall not exceed the safe limits for the respective materials as prescribed in this chapter. The safe compression load per square inch on concrete in concrete piles shall not exceed four hundred pounds. The area of the cross section shall be measured at a point six (6) feet below the head of the pile after the same has been set in place, and the cross section of the pile above this point shall not be reduced.

Sec. 577. (Foundations Other than Pile.)—If foundations of other materials than piles are used, they shall be so proportioned that the loads upon the soil shall not exceed the limits for different kinds of soil than those hereafter given, to-wit:

Sec. 578. (Load for Various Soils.)—If the soil is a layer of pure clay at least fifteen feet thick, without admixture of any foreign substance excepting gravel, it shall not be loaded more than at the rate of three thousand five hundred pounds per square foot. If the soil is a layer of pure clay at least fifteen feet thick, and is dry and thoroughly compressed, it may be loaded not to exceed the rate of four thousand five hundred pounds per square foot.

If the soil is a layer of dry sand fifteen feet or more in thickness, and without admixture of clay, loam or other foreign substance, it shall not be loaded more than at the rate of four thousand pounds per square foot.

If the soil is a mixture of clay and sand it shall not be loaded more than at the rate of three thousand pounds per square foot.

Sec. 579. (Foundations in Wet Soil.—Trenches to Be Drained.)—In all cases where foundations are built in wet soil, it shall be unlawful to build the same unless the trenches in which the work is being executed are kept free from water by bailing, pumping or otherwise, until after the completion of work upon the foundations, and in each case a connection with the street sewer shall be established before beginning the work of laying foundations.

Sec. 580. (Foundations.—Where Not Permitted.)—Foundations shall not be laid on filled or made ground or on loam, or on any soil containing admixture of organic matter.

Sec. 581. (Foundations.—Depth Below Surface.—Least Limit.—Depth Regulated by Sewer.—Exceptions.)—Foundations shall in all cases extend at least four feet below the surface of the ground upon which they are built, and in the case of all buildings forty feet or more in height, foundations shall extend at least to the depth drained by the street sewer in the neighboring streets or alleys; but if such sewers are at a greater depth than ten feet below the sidewalk grade, such foundations need not extend to a greater depth than ten feet, provided that sound, hard soil is found at that depth.

Sec. 582. (Concrete.—Broken Stone.—Sand.—Cement.—Mortar.—Foundations Of.)—Broken stone or concrete in making foundations shall be clean and free from dirt and dust. And sand shall be free from admixture of loam and shall be otherwise clean and sharp.

Cement shall have been kept dry and shall be used fresh from the package; cement which has been permitted to become wet, hard or lumpy before it is mixed into the mortar or concrete shall not be used.

The use of concrete or mortar of any kind, the ingredients of which are not thoroughly and completely mixed and which are not free from lumps, or other unmixed portions of any of the ingredients, is prohibited; and also the use of cement mortar which has become partly or wholly set before use. Concrete foundations wherever used shall have boxes of plank all around them, and the concrete shall be well rammed in individual layers not more than six inches each in thickness. The ramming shall be continued until the water stands on the top of the mass of concrete.

Sec. 583. (Steel Rails or Beams in Concrete.)—If steel or iron rails or beams are used as parts of foundations, they shall be thoroughly imbedded in a concrete, the ingredients of which shall be such that after proper ramming the interior of the mass will be free from cavities, the beams or rails shall be entirely enveloped in concrete, and around the exposed external surfaces of such concrete foundations there shall be a coating of a standard cement concrete not less than four inches thick.

Sec. 584. (Concrete Foundations.—Steps.—Safe Load Where Reinforced by Beams.)—If concrete foundations are used by themselves and without the insertion of iron or steel beams or rails, the offset on top of same shall not be more than two-thirds the height of the respective courses, and such concrete foundations shall not be loaded more than twenty-five thousand pounds per square foot. If reinforced by iron or steel beams or rails, the loads and offsets in the same shall be so adjusted that the fiber stress upon the metal, if iron, shall not exceed twelve thousand pounds per square inch, or, if steel, that the fiber stress shall not exceed sixteen thousand pounds per square inch.

Sec. 585. (Dimension Stones.—Safe Load.)—Dimension stones shall have uniform beds and the offsets in the same, where two or more layers are used, shall not be more than three-quarters of the height of the individual stones. They shall be set with full beds of cement mortar under their entire area, and in such manner that they will not rock after being set. Dimension stones in foundations shall not be subjected to a load of more than twenty thousand pounds per square foot in tiers.

If the beds of the stones are dressed and leveled off to a uniform surface and the stones are set in a standard cement mortar, this strain may be increased to twenty-five thousand pounds per square foot.

Sec. 586. (Rubble Stone.)—Rubble foundations and rubble walls shall be built of approximately square and flat bedded stones, well and thoroughly bonded in both directions of the walls, each stone thoroughly bedded in mortar under its entire area. Wherever walls of any kind are used as curb walls, their exterior surfaces shall be rendered approximately water tight by a coating of a standard cement mortar.

Sec. 587. (Brick.—Soft.—Use Of.—Bond.—Safe Load.)—The use of soft bricks is prohibited in all parts of buildings exposed to the weather and in internal or external piers or bearing walls. The bond of brick work shall be formed by laying one course of headers for every five courses of stretchers. Brick work in walls laid in a standard Portland cement mortar shall not be loaded more than twenty-five thousand pounds per square foot. Brick work laid in an ordinary cement mortar shall not be loaded more than eighteen thousand pounds per square foot. Brick work in walls laid in lime mortar shall not be loaded more than thirteen thousand pounds per square foot.

Sec. 588. (Walls.—Ledges.—Joists Supports.—Walls Around Stairs, Elevators and Shafts.)—Whenever walls sixteen inches or less in thickness shall be used for the support of ordinary joists in buildings of all classes, ledges of the thickness of the furring, lath and plaster shall be formed between such joists and shall be carried up and leveled off on the line of the tops of the joists, or standard cast iron joist boxes shall be used for the support of such joists.

Where a stairway or an elevator shaft or an air shaft is surrounded by brick walls, such surrounding brick walls may be built sixteen (16) inches thick, excepting that the upper fifty (50) feet of the height may be built twelve (12) inches thick, but the length or breadth, or either, of such a stairway or elevator shaft or air shaft shall not exceed twenty-five (25) feet, and in no case shall the load on the brick of such wall or walls exceed the safe limits of load specified for brick work in this chapter.

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Sec. 589. (Pressed Brick Facing.—Bond Joints.)—If pressed brick facings are used, they shall be bonded into their backing every seventh course. Bond shall be established by solid headers or by blind headers. In the case of piers faced with pressed brick, only solid headers shall be used, but bond stones or iron bond plates may be substituted for such headers. Pressed brick in all cases shall be so laid as to have a full bed of mortar under its entire surface. The laying of pressed brick merely with a joint all around the outer edge of the bricks shall be unlawful.

Sec. 590. (Brick Piers.—Offsets.—Bond Stone.—Cap Stone.)—In building brick piers there shall be provided at every offset in each pier, or at every point where such brick pier receives the load, a bond stone at least eight inches thick or a plate of rolled iron or steel not less than one-fourth of an inch in thickness, which stones or plates, if at the top of such pier, shall cover its entire surface, and shall in all cases be adapted to receiving the load to be imposed and shall be made of a strength which will keep the fiber strain upon the material used within the limits elsewhere herein stated.

Sec. 591. (Stone Facing Without Bond Courses.)—Stone may be used as facing for brick walls under the following conditions: If the facing is ashlar, without bond courses, and the individual course thereof measure in height between bond stones more than six times the thickness of the ashlar, then each piece of ashlar facing shall be united to the brick work with wrought iron anchors at least two to each piece and reaching at least eight inches over the brick wall, and hooked into the stone facing as well as the brick backing. Wherever ashlar as before described is used, it shall not be counted as forming part of the bearing surface of the wall, and the brick backing shall be of the thickness of wall herein specified for the different kinds of building.

Sec. 592. (Stone Facing with Bond Courses.)—If stone facing is used with bond courses at a distance apart of not more than four times the thickness of the ashlar, and where the width of bearing of the bond courses upon the backing of such ashlar is at least twice the thickness of the ashlar, and in no case less than eight inches, then such ashlar facing shall be counted as forming part of the wall and the total thickness of wall and facing shall not be required to be more than herein specified for walls of the different classes of buildings.

Sec. 593. (Stresses.—Cast Iron.—Fiber.—Strains.—Length.)—The stresses in materials used in construction produced by the calculated strains due to their own weight and applied loads shall in no case exceed the following:

CAST IRON.

Extreme fiber strain tension.....	2,500 lbs.
For columns	10,000 lbs.
Reduced by Gordon's formula. Reduced for eccentric load.	
No cast iron column shall have a length to exceed twenty-four times its diameter, or least side.	

Sec. 594. STRESSES IN POUNDS PER SQUARE INCH.

	Wrought Iron.	Steel.
Extreme fiber stresses, "I" beams and shapes.....	12,000	16,000
Extreme fiber stresses, built beams.....	10,000	15,000
Tension	12,000	15,000
Shearing	7,500	10,000
Direct bearing pins and rivets.....	15,000	20,000
Bending on pins	18,000	22,500
*For columns and compression members.....	12,000	15,000

*Reduced for ratio of length of columns to its least radius of gyration by approved modern formulas, and reduced for eccentric loading.

Sec. 595. TIMBER—STRESSES IN POUNDS PER SQUARE INCH.

	On Extreme Fiber	Shearing Along Grain	Compression Per- pendicular to Grain
White Pine and Spruce.....	750	80	150
White Oak	1,000	150	250
Long-leaved Yellow Pine	1,250	100	250

Sec. 596. (Posts with Flat Ends.—Stresses per Square Inch.)—

L. Length of posts in inches.

D. Least side or diameter of post in inches.

S. Stress per square inch.

White Pine Spruce.		L. L. Yellow Pine.		White Oak.
L. D.	S.	L. D.	S.	S.
0-10	625	0-15	1,000	750
10-35	475	15-30	875	650
35-45	375	30-40	750	560
45-50	300	40-45	625	460
		45-50	500	375

GENERAL PROVISIONS.

Sec. 597. (Walls.—Eight-Inch Brick Wall.—Height Limited.)—In no case, in any class of building, shall any eight-inch brick wall be more than fourteen feet in height.

Sec. 598. (Cement Concrete Walls.—Solid.)—Approved cement concrete of the same thickness as is required where common brick or rubble stone is used, may be substituted for either of these materials wherever either is called for in this chapter.

Sec. 599. (Walls.—Thickness Of.)—The thickness of walls set forth in the tables for the various classes of building shall, for each class of buildings, apply to all external enclosing walls, and also to such internal walls as may be required under the specifications of the different classes of buildings.

Sec. 600. (Bay Windows and Light Shafts.—Material For.)—Bay or oriel windows and light shafts may be built of combustible material, as specified in Section 287 of this ordinance.

Sec. 601. (Buildings.—Height Of.)—The limits of heights of buildings hereinbefore given for non-fireproof buildings, shall be from the average established sidewalk level to the highest point of roof thereof.

No buildings shall be erected in the city of greater height than two hundred and sixty feet from the sidewalk level to the highest point of external bearing walls. The erection of parapet walls or of balustrades constructed entirely of incombustible material is permitted above the roof level of buildings of all classes, and in addition to the heights herein fixed for the same. (See Sections 540 and 541.)

Sec. 602. (Floor Areas.—Computation Of.—For All Classes of Buildings.)—Stairs in Common.)—The floor areas of all buildings shall be computed from the dimensions taken on the inner side of the exterior or surrounding walls on the floor of the third story, and the areas of courts, of elevator shafts, of enclosed stairs, if enclosed with incombustible materials, and of chimneys, shall not be considered as a part of such floor areas.

Where two areas of the same building adjoin, and are separated by fireproof dividing walls, they may have a stairway in common. Provided, however, in fireproof buildings such stairways shall be of incombustible material, enclosed in fireproof partitions, and access to such stairway shall be direct from each such area. Provided, however, in buildings of mill, slow-burning or ordinary construction, such stairways shall be of incombustible materials, enclosed by brick walls, and that doors to such stairways shall be automatic, self-closing standard iron doors, as described in Section 260 of this chapter, and all materials inside of such brick walls shall be fireproof or incombustible material.

Sec. 603. (Wind Pressure.—Precautions Against.)—In the case of all buildings the height of which is more than one and one-half times their least horizontal dimension, allowances shall be made in both vertical and horizontal construction for wind pressure, which shall not be figured at less than thirty pounds for each square foot of external wall surface.

Sec. 604. Basement.—Meaning Of.—Cellar.—Meaning Of.)—Wherever in this chapter the words "basement story" are used, it is intended to mean that the floor of such story is at a distance of two feet or more below the level of the sidewalk, and that its height does not exceed eleven feet in the clear. If the floor of such story is nearer than two feet to the sidewalk grade, or if the ceiling of such basement is more than nine feet above the sidewalk grade, it shall be counted as the first story of the building in which it occurs, except in buildings of Class VI. and Class VIII. as defined in Sections 246 and 248 of this chapter.

"Cellar" is a story, the height of which is more than two-thirds below the level of the grade at the building.

Sec. 605. (Sub-Basements and Cellars.—Construction Of.)—No building may have more than one basement or cellar of ordinary or slow-burning or mill construction, all additional basements or cellars shall be of fireproof construction, as described in this chapter, all elevator enclosures shall be of brick from the lowest basement floor level to the first story floor, and all stairways shall be enclosed in fireproof partitions from the lowest basement floor level to the first story floor level with automatic closing standard iron doors, opening outwards.

In cases where a pipe, conduit, dumb-waiter, cable, wire, conveyor or belt, or any combination thereof passes from one basement to another through a floor the opening in the floor shall be enclosed as specified in Sections 524 and 525 of this chapter.

The number and width of stairs from the lowest basement floor to the first story shall be the same as required for the four highest stories of a building of the same area.

Sec. 606. (Enclosures Upon Roofs.—Parapets and Balustrades Upon Roofs.)—It shall be permitted to erect on the roofs of all buildings more than sixty feet and less than one hundred feet high, skylights, enclosures for water tanks and enclosures for elevator machinery, the construction of all of which enclosures shall be entirely of incombustible material; provided, however, that the roofs of same may be built of mill or slow-burning construction.

Sec. 607. (Fire Walls.—When Dispensed With.)—Fire walls of brick not less than twelve inches thick shall be built extending above the roofs of buildings if such roofs are flat, and also above the roofs of all buildings where the same abut against another building, or where the same stand upon any line of any lot, excepting street or alley lines. Provided, that where eight-inch walls are permitted in the top story of buildings, or as provided in Classes III. and VI. for buildings not over three stories high, the fire walls shall be of the same thickness. Such fire walls, where they stand upon lot lines, or where they are over the dividing walls in the interiors of buildings where such are called for by this chapter, by reason of the great area of such buildings, shall extend at least three feet above the roofs of such buildings. Fire walls upon street and alley lines shall extend not less than eighteen inches above the roofs of such buildings. Fire walls may be dispensed with on street and alley lines if the tops of the roof boards and roof joists are protected against fire for a distance of at least five feet from such street or alley lines by a coating of deafening mortar on hollow tile or porous tile at least two inches thick. Fire walls at street and alley lines may also be dispensed with in all cases where the entire framing and materials of the roof shall be made strictly fireproof.

Walls facing upon courts and light shafts shall be treated as in the same category with walls facing upon streets and alleys.

Fire walls shall be covered with a weatherproof coping of incombustible material.

Sec. 608. (Window and Door Sills.—Columns and Lintels Supporting Store Fronts.—Incombustible.)—Window and door sills shall be made of incombustible material. Oak timber used for door sills and not less than eight inches thick by the full width of the wall in which such sills occur, shall, for the purpose of this chapter, be counted incombustible, but no other form or use of wood construction shall be considered incombustible.

The columns and lintels supporting store fronts in buildings within the fire limits of more than one story in height shall be made of incombustible material.

Sec. 609. (Roofs.—Shingle or Gravel.)—The use of single roofs or of other forms of combustible roof covering upon buildings erected or altered within the fire limits is prohibited. Provided, however, that shingle roofs may be placed on buildings not exceeding two stories in height and two thousand square feet in area, but the shingles used on such roofs shall first have been dipped in fire-resisting paint, such fire-resisting paint to be approved by the Commissioner of Buildings.

Roofs whose slope is not more than three inches per foot horizontal, and the covering of which is made with a composition of felt and gravel, shall be considered incombustible under the provisions of this chapter, and may be used upon buildings of all classes.

Sec. 610. (Roofs.—Construction of.—Pitch Of.—Strength Of.)—In the case of all buildings less than sixty feet in height, roofs having a slope of more than specified for composition roofs, may be made of timber and board construction, and shall be covered with incombustible material, except as provided in Section 609 of this chapter. The roofs upon buildings sixty or more feet and less than ninety feet high, and of greater slope than three inches to the foot and less slope than thirty degrees with the horizon, shall, if made of timber construction, have an incombustible covering upon the roof boards, which shall be made either of mortar or porous terra cotta or plaster boards, or other incombustible material, and which shall be at least two

inches thick. If this covering is made upon the roof boards, wooden strips shall be inserted and securely fastened to the wooden substructure at regular intervals between the incombustible covering, and a weatherproof covering of incombustible material.

The roofs of all buildings of every kind and class shall be designed and constructed in such a manner that they will bear a load in addition to the weight of their structure and covering of at least twenty-five pounds for each square foot of horizontal surface.

Sec. 611. (Roofs.—Pipes Carrying Water From.)—The water from all roofs shall be carried to the street sewers in metal conductor pipes, which shall be continually maintained in such condition that leaks therein will not cause the water to soak into the walls or any other part of the building.

Sec. 612. (Cornices.—Gutters.—Eaves.—Parapets.—Bay Windows.)—Where sheet metal cornices or external metal sheet gutters are used, their entire framework and covering shall be of metal, and the walls shall extend behind all such cornices or gutters along their entire height. All metal work in and about any cornice, gutter, eave or parapet, or in or about any bay, or oriel window, shall be supported by suitable brackets placed not more than four feet apart and firmly secured to the wall. Wood shall not be used as the support of any gutter or cornice for buildings of one hundred feet or more in height.

Sec. 613. (Towers.—Domes and Spires.—Construction Of.)—Towers, domes and spires may be built on top of the roofs of buildings, but shall not occupy more than one-fourth of the street frontage of any building. Such towers, domes or spires, if any part thereof is built to a height of more than sixty feet and less than ninety feet, shall be of slow-burning construction, and if of greater height than ninety feet above the sidewalk shall be of fireproof construction; and in all cases where the area of such spire, dome or tower exceeds one hundred square feet, its supports shall be carried down to the ground, and shall be, if the construction supported is more than sixty feet and less than ninety feet high, of slow-burning construction, and if more than ninety feet high, of fireproof construction.

Sec. 614. (Skylights.—Construction Of.—Glass In.)—Any skylight on the roof of any building, other than a frame building, shall have the sides, sashes and frames constructed of metal; or of wood, metal clad on all exterior surfaces.

The glass in all such skylights, except in buildings of Classes III. and VI. not exceeding three stories in height shall have at least six inches over same, a strong wire netting (wire not lighter than No. 8 and mesh not coarser than one and one-half inch by one and one-half inch), unless the glass contains a wire netting within itself.

Sec. 615. (Porches.—Verandas.—Porticos.—Balconies.—Construction of Inside Fire Limits.)—If verandas, porches or porticos are enclosed, the enclosing walls shall be made of incombustible material, the only exception being in case such porticos or verandas are to be made part of a storm house or of a storm door enclosure, which, however, shall in no case be more than twelve feet high, nor shall it occupy a greater frontage than two feet more than the width of the inner doors for which the storm doors are made.

Sec. 616.—(Sidewalks.—Occupation of by Parts of Buildings.)—The use of any part of the sidewalks for steps or for open areas is prohibited.

Sec. 617. (Chimneys.—Walls Of.—Height Above Roof.)—Amended June 5, 1906, to read as follows:

No chimney shall be built with less than four inches thick brick wall, and no chimney having a greater flue area than two hundred and sixty square inches shall have walls less than eight inches thick; provided that in all cases where chimneys are built with walls less than eight inches thick the same shall have flue liners of fire clay or terra cotta in their entire length. Except that where flues are to be used for gas grates or gas ranges, the flue lining may be omitted, but the inside of the flue shall be smoothly plastered. Chimneys that are built of fireproof composition composed of cinders, cement and burnt sand shall be no less than two and one-half (2½) inches thick, and perfectly smooth. Chimneys that are built of fireproof composition shall be built in two sections capable of being shoved into one another where it touches the roof; the flue hole of the base stone must be much larger than the lower part of the chimney, so that the said base stone incases the lower portion of the chimney, and both can move independent without cracking a joint in a section; there being an air space or a cooler between the flue hole of the base stone and the lower portion of the chimney. It is not necessary that this chimney should be lined with fire clay or terra cotta, as it is itself a fireproof composition. The use of unprotected metal flues inside of buildings will not be permitted.

Every chimney having an area of not more than two hundred and sixty square inches shall be carried up to at least five feet above the highest part of the roof of

the building of which such chimney is a part, if such roof is a flat roof. If the roof is a pitched roof the chimney shall be carried up at least two feet above the highest point of same.

Sec. 618. (Chimneys.—Interior.—Walls Of.)—Chimneys having a greater flue area than six hundred square inches shall, if built of brick, have surrounding walls of at least sixteen inches of brick work, and such walls shall be built hollow with at least four inches hollow space in such walls, at a height of fifty feet above smoke inlet the thickness of the surrounding brick work may be reduced to twelve inches, but in all cases the surrounding walls of chimneys of this or any other size shall be so proportioned that the brick work in same will not be subjected to a greater stress than elsewhere herein fixed as a maximum safe stress for brickwork. For chimneys having a greater flue area than one thousand six hundred square inches the thickness of walls shall be increased above the thickness above specified, four inches for each increase of one thousand square inches or fractional part thereof.

Sec. 619. (Chimneys or Flues.—Height above Roof.)—All flues having a greater area than two hundred and fifty square inches, and not more than six hundred square inches, shall be carried up at least twelve feet above the highest point of roof or building of which they form part; and all flues having a greater area than six hundred square inches and not more than nine hundred square inches, shall be carried up at least twenty feet above highest point of roof. All chimneys having a greater area than nine hundred square inches shall be carried to a height of at least twelve feet above any roof within a radius of sixty feet; provided that the top of the chimney shall be not less than twenty feet above the highest point of the roof of the building of which it forms a part.

Sec. 620. (Chimneys or Flues.—Linings Of.)—All flues having a greater area than four hundred square inches shall be lined on the inside with insulating material, which lining shall start at least two feet below the smoke inlet, and for flues having an area of from four hundred to six hundred square inches shall extend twelve feet above smoke inlet, and for all flues of more than six hundred square inches, and not more than one thousand six hundred square inches, shall extend twenty feet above smoke inlet, and for all flues having a greater area than one thousand six hundred square inches, shall extend at least thirty feet above smoke inlet. If an internal smoke pipe of metal is used, so much of the brick work as is inside of the insulating cavity of the stack may be omitted. Metal smoke-stacks shall, however, be lined with insulating material for at least thirty feet of their height.

If internal stacks in buildings be made of metal then they shall be entirely surrounded within the building with a fireproof material which shall thoroughly protect the building from fire, and there shall be an air space, not less than four inches in the smallest part between the fireproofing and the metal stack.

Sec. 621. (Chimneys.—Interior.—Framing Around.)—No joists or girders shall rest and be supported on the walls of any chimney, and the framing around chimneys of all kinds shall be so constructed that in no case will any joists or timbers be placed nearer than two inches from the outside face of walls of flues, and in no case shall the distance from the inside of any flue to any joists or timbers be less than seven inches.

The foregoing shall apply only to chimneys which are enclosed by, or form part of, the interior of any building.

Sec. 622. (Chimneys.—External.—Location Of.—Built of Iron or Steel.)—Chimneys may be built outside of the walls of existing buildings (but not in such manner as to encroach upon any street or alley), and shall be built as follows:

If at least one side of such chimney abuts entirely upon the wall of an existing building and the chimney is throughout its entire length securely and firmly anchored to the walls of such existing building, the wall of such chimney may be built of hollow tiles, in which case, however, it shall have a cast iron base, lined with fire brick, and extending to a height of at least ten feet above the street or alley grade.

Such external chimney may also be built of rolled steel or iron not less than one-fourth inch in thickness, and lined with insulating material, laid in fire clay, for at least thirty feet above street or alley grade, or it may be built throughout its entire height of cast iron, in which case the first ten feet above street or alley grade shall be lined with insulating material; provided, however, that in chimneys not exceeding five hundred square inches in flue area, the upper twenty-five feet may be constructed of steel or iron not less than one-eighth inch thick.

Sec. 623. (Chimneys.—Isolated.)—Isolated chimneys shall be so designed and constructed that the stress upon any part thereof, due from the weight of the stack itself and from wind pressure, shall never exceed the safe limits as provided in this chapter.

Sec. 624. (Chimneys or Smokestacks.—Foundation Of.)—The foundations of chimneys or smokestacks, whether inside or outside of buildings, or whether connected with the same or isolated, shall be designed and built in conformity with the provisions relating to foundations of buildings hereinbefore given.

Sec. 625. (Smoke Flues Passing Through Partitions.—Woodwork Around.)—Where smoke flues of diameter of six inches or less pass horizontally through a wood or a plastered stud partition, they shall be surrounded by a ventilated thimble of incombustible material.

Where a smoke flue of a greater diameter than six (6) inches passes through a wood or plastered stud partition, it shall be surrounded either by a body of brick, hollow tile, porous terra cotta or other incombustible substance, measuring at least eight (8) inches all around such smoke flue. Smoke flues of less diameter than twelve inches shall be kept at least twelve inches distant from any combustible partition, ceiling or floor, and such woodwork immediately over and for a distance of two feet on each side of such smoke flue shall be covered with sheet metal or with porous terra cotta, hollow tile or with plaster.

Smoke flues of greater diameter than twelve inches and less area than six square feet, shall be kept at least twenty inches away from any woodwork, and such woodwork shall be protected as before specified for the smaller smoke flues to a distance of four feet on each side of such smoke flues.

Wherever smoke flues of larger area than six square feet are used they shall be kept at least three feet distant from any woodwork, and such woodwork for a distance of at least six feet on either side of such smoke flues shall be protected as before specified for smaller flues.

Sec. 626. (Floors.—Protection Of.—Around Boilers, Furnaces, Etc.)—Wherever steam boilers or furnaces or ovens, coffee roasters or other structures in which fires are maintained, are set inside of a building, or in a room with wooden floor or ceiling construction, the floor of the same shall be protected by a covering of brick or concrete not less than five inches thick set in mortar upon a continuous sheet metal bearing plate not less than three-sixteenths of an inch thick, all the joints of which are to be securely riveted, and the edges of which are to be turned up five inches all around. This foundation of sheet metal and brick and concrete shall extend under the whole of the fire box and ash pit of such steam boiler or furnace or other structure, and to a distance of not less than ten feet in front and at least four feet on the other three sides of same.

Sec. 627. (Ceiling.—Protection Of.—Around Boilers, Furnaces, Etc.)—The space between the tops of such steam boiler or furnaces and any wood ceiling construction shall in no case be less than three feet, unless such boiler be a low pressure boiler, in which case such space shall be not less than eighteen inches, and the under side of such wood ceiling construction shall in all cases be protected either by three coats of plastering or metallic lath or wire netting, or at least two inches of porous terra cotta plastered on the under side, or by a covering of hollow tile with two air spaces at least one-half inch each between the wood and the under surface thereof, which under surface shall also be covered with a heavy coat of plastering.

Sec. 628. (Boilers.—Location Of.—Permit For.)—In all cases boilers shall be so placed as to give ample room between any ceiling, wall or partition to connect or operate any valves or pipes or other connections used on such steam boilers, and in buildings of 4,000 or more square feet in area, the size, number and location shall be marked on the plans before a permit is issued by the Building Department.

Sec. 629. (Cupolas of Foundries.)—Cupolas of foundries shall extend at least ten feet above the highest point of any roof within a radius of forty feet of such cupola, and shall be covered on top with wire netting.

Sec. 630. (Pipes for Distribution of Hot Air.—Registers.)—Where pipes are used for the distribution of hot air from a hot air furnace, such pipes shall be made of metal and shall be double. The space between the two metal pipes shall be at least one-half inch. Such pipes are to be made with air tight joints and to be securely fastened to the partitions through which they pass.

The openings in floors for hot air registers shall be surrounded with borders of incombustible material not less than two inches wide, and firmly and securely set in place. The register boxes shall be double, the distance between the two thicknesses of tin being at least one inch.

Sec. 631. (Pipes, Ducts and Registers.—Material For.)—Where the air conveyed through pipes is heated in an ordinary hot-air furnace, or in any other apparatus by direct contact of the air with a fire box, the material used for these double ducts, pipes and register boxes shall be bright tin, and the joints shall be double.

seamed, but not soldered. Where the air is heated by contact with hot water or steam pipes, any other sheet metal may be used for the pipes, and the use of double pipes is not obligatory.

Sec. 632. (Doors and Windows.—When Required to Be Closed.—Fire Resisting Glass.)—Wherever the distance between doors and windows in buildings of Classes I., II., IV., V., VII. and VIII., on opposite sides of alleys or courts shall be less than thirty feet, or wherever the distance between such doors and windows and any inside lot line of any lot upon which any such building is erected is less than fifteen feet, or wherever the distance between such doors and windows and the alley line (where the alley is less than thirty feet wide) is less than fifteen feet, such windows and the glazed portion of such doors shall be made of fire-resisting glass, set in frames of incombustible material.

Where the windows in buildings of Class I. on lot line courts are less than two feet from the lot line the sashes shall be stationary.

The provisions of this section shall not apply to frame buildings of any class.

As amended by ordinance of October 22, 1906.

This section shall not apply to buildings of Class I., one story in height and having a floor area of less than twelve hundred and fifty square feet, nor shall it apply to buildings of Class II., not more than two stories in height.

As amended by ordinance of February 18, 1907.

Sec. 633. (Class of Building Not to Be Changed Without Conforming to Provisions of This Ordinance.)—If buildings, the uses of which bring them within any of the classes mentioned in this chapter are to be applied to the uses of any other class for which a better system of construction is called for by this chapter, the construction and equipment of such buildings shall first be made to conform to the requirements of this chapter as specified for their intended use. And it shall be unlawful to apply any such building to a new or different use than that to which its structure and equipment adapts it under this chapter, unless the requirements of this chapter for such new or different use shall first have been complied with, and a permit for such alteration of use shall have been first obtained from the Commissioner of Buildings.

Sec. 634. (Alteration of Existing Buildings.)—Nothing in this chapter contained shall be considered as requiring alterations in the construction or equipment of buildings in existence at the time of the passage of this chapter, unless such buildings shall not have sufficient or adequate means of egress therefrom or ingress thereto by reason of insufficient or inadequate stairways, or stairways improperly located, or insufficient or inadequate elevators or elevator equipment, doors, fire escapes, windows or other means of egress or ingress.

Where it shall appear to the Commissioner of Buildings that any such building has inadequate or insufficient means of egress therefrom or ingress thereto, as aforesaid, he shall notify the owner, agent, or person in possession, charge or control of such building of such fact and direct him forthwith to make such alterations and changes in the construction or equipment of such building as are necessary to be made in order to promote the safety of the occupants of such building, and of persons using the same and of the public.

If, however, it is desired to enlarge, or in any manner materially modify the construction of any existing building, or to make change in its use or occupation which will transfer it from one class as recognized by this chapter to another class, then before such enlargement or structural change or modification of building is made, or before such change in its use or occupation may be made, the entire building shall be reconstructed or modified in such manner as to bring the same when enlarged or altered, or when occupied for its new and different purposes, in accordance with the provisions of this chapter.

Sec. 635. (Walls of Altered Buildings.—Increasing Thickness Of.)—If the walls of a building are not of sufficient thickness to comply with the requirements of this chapter for an enlarged or modified building, then the thickness of the existing walls shall be increased by building alongside of them a new wall, which shall not, however, be less in any part thereof than twelve inches thick, and which shall be increased in thickness by four inches for at least every forty feet in the height of such wall. Such new wall shall be laid in Portland cement mortar and shall be anchored to the old wall (bonding with brick or masonry will not be considered as complying with this chapter); and if an increase in the height of the building is contemplated, the wall from the top of the old wall shall be built jointly upon the new and old walls. If solid masonry buttresses are introduced in connection with such thickening and strengthening of existing walls, the intervening wall may be reduced to eight inches in thickness, provided such buttresses are sufficient in num-

ber and in area to make the resultant structure of equal strength with the solid wall already specified. Provided, however, that steel or iron columns or beams may be used instead of such new wall, such columns or beams to be bolted or bonded to the existing wall in a manner satisfactory to and approved by the Commissioner of Buildings.

Sec. 636. (Walls.—Party.)—The provisions of the preceding section shall also apply to all cases where existing party walls are to be joined to for the erection of new buildings. But in the case of party walls, which at the time of their erection were built in accordance with the terms of the city ordinances then in force, such walls, if sound and in good condition, may be used without increase of thickness for any building not higher than and of the same class as the building for which the original wall was built.

Sec. 637. (Walls.—Erection Of.—Walls and Skeleton Framework Securely Braced.)—In the erection of buildings of masonry construction, no wall shall be carried up at any time more than two stories above another wall of the same building. The walls and skeleton framework of all buildings shall be kept securely braced and otherwise protected against the effects of the weather during all building operations.

Sec. 638. (Tanks on Roofs.—Permits.—Fees.)—It shall be unlawful for any person to construct, maintain, or to allow or permit to remain, in or upon the roof of any building in the city, any water tank of a larger capacity than four hundred gallons, unless such tank shall rest upon a good and sufficient foundation of solid brick or stone masonry, or upon iron girders set on steel plates, which rest upon a good and sufficient foundation of solid brick or stone masonry, or upon iron or steel construction; provided, however, that no water tank of a capacity exceeding four hundred gallons shall be constructed in or upon any building without first obtaining therefor a permit from the Commissioner of Buildings and paying therefor a fee of two dollars.

Sec. 639. (Stairs and Fire Escapes.—Obstruction Of.)—It shall be unlawful under any circumstances to close up or obstruct during the occupation for business purposes of any building, the stairways or fire escapes or the approaches leading thereto, and no change in the position or construction of any such stairway or fire escape shall be made, unless the permission so to do of the Building Department first shall have been obtained.

ARTICLE XVII.

FRAME BUILDINGS.

Sec. 640. (Permits for Raising or Altering Buildings.—Requirements.)—Permits to alter or raise frame buildings shall be given, provided they do not involve an enlargement or raising of such buildings beyond the limits of dimensions herein prescribed for frame buildings, and if the stresses upon the material thereof are kept within the safe limit of stresses herein prescribed in this chapter, and if, further, such frame building has not been damaged to any extent greater than fifty per cent of its original value by fire, wear and tear, and action of the elements or otherwise. Provided, however, where any frame building is raised for the purpose of erecting a basement story under the same, the walls inclosing such basement shall be of masonry.

Sec. 641. (Strength of Timber Constructions.—Outside of Fire Limits.)—The provisions of this chapter as to the strength and stability of timber constructions shall also apply to the construction of frame buildings outside of the fire limits.

Sec. 642. (Frame Buildings Prohibited.—Exception.)—Hereafter no frame building shall be erected within the fire limits of the city, except where express provision is made in this chapter therefor.

Outside of the fire limits it shall be lawful to erect frame buildings not exceeding forty feet in height from the sidewalk to the highest point of roof. If such frame buildings have a basement story of masonry, their height above the sidewalk may be made not to exceed forty-five feet.

Sec. 643. (Frame Buildings Inside Fire Limits.—Altered or Enlarged.)—No existing frame buildings inside the fire limits shall be altered or enlarged beyond the limit of height and dimensions described in Sections 642 and 646 of this chapter.

Sec. 644. (Frame Buildings Inside the Fire Limits Changed Into Flat Buildings.—Fire Walls.)—Whenever any frame building inside the fire limits shall be remodeled, altered or changed for the purpose of using the same for flats or apartments, or whenever such frame building shall be occupied for flat or apartment purposes, each suite of apartments in such building shall be separated from every other suite of apartments in such building by a wall of incombustible material, of such dimensions and thickness as required by this chapter.

Sec. 645. (Frame Buildings.—Raising.—Requirements.—Changing Gable or Hip Roofs to Flat Roofs.)—Permission may be granted by the Commissioner of Buildings for the raising of existing frame buildings, whether within or without the fire limits, to the limits of height hereinbefore fixed for new frame buildings, and no more. The Commissioner of Buildings is also authorized to issue permits for changing gable or hip roofs of existing frame buildings to flat roofs, and for the raising of walls incident to such change. But if such hip or gable roof is changed to a flat roof and the walls raised in connection with such change, the total cubic contents included by the walls so raised and the roofs so altered shall not exceed the cubic contents originally included in such gable or hip roofs.

Sec. 646. (Frame Buildings.—Damaged.—Repairing.—Limitations.)—It shall not be lawful to repair or reconstruct or remove any frame building which has been injured more than fifty per cent of its original cost by wear and tear, by the effects of the elements or by fire.

Sec. 647. (Lot Lines.—Requirements as to.—Number.—Dimensions.)—Frame buildings shall not be built nearer than one foot to any line of the lot upon which they are built, street and alley lines excepted. It shall not be lawful to erect a frame building wider than forty feet nor deeper than seventy feet, unless such building be divided by a fire wall or fire walls, built of incombustible material and of a thickness to be approved by the Commissioner of Buildings, so that no more than two thousand eight hundred square feet of superficial area shall be contained in any section or part of such building, inclosed by such fire wall. If more than one frame building is built in the direction of the depth of any one lot, such buildings shall not be built with a less distance than ten feet between them.

Sec. 648. (Chimneys in Frame Buildings.—Chimney Flues Through Partitions.)—Chimneys in frame buildings shall be built of brick, or of hollow tile, with a double tile wall around the smoke duct; all joints, whether in tile or in brick chimneys, shall be well filled with mortar and neatly pointed on the outside. Brick chimneys shall have flue linings of fire clay on the inside where the inclosing walls are less than eight inches thick. The wood framing of frame buildings shall be trimmed around chimneys in such manner as not to come within two inches of the same.

Metal smoke pipes or tile flues of single thickness shall not extend through the floors or through the ceiling or roof of any building; and where such smoke pipes or tile flues pass through partitions the woodwork of such partitions shall be protected either by a course of brick built all around such smoke pipes or tile flues, or by a thimble made of bright tin, the two rings thereof being at least three inches apart, with proper ventilating holes provided in the outer covering of the same on both sides of the partitions.

Sec. 649. (Frame Buildings Carried to Uniform Height.)—Frame buildings, the different parts of which are of different heights, may be carried up to a uniform height, provided the greatest height thereof does not exceed the limits of height prescribed in this chapter for frame buildings.

Sec. 650. (Basement or Story Placed Beneath Frame Buildings.)—A frame building may be raised for the purpose of erecting a basement or story, or both, thereunder, but the principal floor of such frame building shall not be raised to a higher level than sixteen feet above the sidewalk grade of the sidewalk upon which such premises abut. The walls inclosing such basement or story shall be of masonry and not less than twelve inches thick, excepting that when a one-story frame building is raised and has a basement only built thereunder the masonry wall of such basement may be eight (8) inches thick above grade and twelve (12) inches thick below. The foundations of such walls shall be constructed as provided in this chapter. Provided, however, that no frame building shall be raised for the purpose of constructing a basement or story, or both, under the same to a greater height to the top of its roof than that elsewhere herein given as the maximum height above grade for frame buildings. The thicknesses of walls hereinabove required shall also apply to new frame buildings.

Sec. 651. (Sheds.—Frame.—Requirements.)—Sheds not exceeding fourteen feet in height from the ground at the highest point thereof, and not exceeding three hundred feet in area, with an incombustible roof, may be constructed of wood within the fire limits. Such sheds shall not be located on the front part of any lot, nor shall they be used as a dwelling or as an addition to a dwelling house, or for any business purpose whatever, nor shall more than one shed be erected on any one building lot of twenty-five feet in width.

Sec. 652. (Sheds.—Open Shelter.—Height of Walls and Foundation.)—Open shelter sheds may be constructed within the fire limits, provided they have incombustible roofing and the highest point of the roof thereof is not over fifteen feet above the ground, and provided that the roofing be supported on sufficient posts or piers.

Such sheds shall have no combustible inclosing walls or wooden floors. No fence shall be used for the back or sides of such shed.

If it is desired or intended to inclose an open shelter shed, the inclosing walls shall be made of brick, stone, hollow tile or other incombustible material, and such walls shall have foundations extending to solid ground and at least four feet below the surface of the ground.

Sec. 653. (**Sheds.—Coal Sheds Along Railroad Tracks.**)—Open shelter sheds to be used for the storage or handling of coal may be erected within the fire limits upon, along or adjacent to steam railroad tracks or along navigable waters; provided, such sheds shall have incombustible roofing and shall not exceed thirty-five feet in height from the ground to the highest point of the roofing. If it is desired or intended to inclose any such shed, inclosing walls thereof shall be covered with incombustible material. No such coal shed shall be built upon any lot or parcel of ground fronting upon any street within seventy-five feet of any building used exclusively for residence purposes, unless the consent of the owners of the majority of the frontage on both sides of such street between the two nearest intersecting cross streets shall first have been obtained by the person or corporation desiring to erect and maintain such coal shed.

Sec. 654. (**Lumber or Junk Yards.—Lumber or Junk Not to Be Piled Near Residences Except by Consent.**)—No person or corporation shall establish, maintain, conduct or operate any lumber yard or place at, upon or in which new or second-hand lumber is kept for sale or is stored for seasoning or drying, or where old iron or junk is kept or stored on any premises fronting on any street in any block where two-thirds of the buildings on any street bounding any such block are used exclusively for residence purposes, unless the written consent of the owners of a majority of the frontage on both sides of all the streets bounding the block in which it is proposed to locate, establish, conduct or maintain such lumber yard or place be first obtained by the person or corporation desiring to establish, maintain or operate such lumber yard or place consenting to the issuance of a license for the establishment, keeping or maintenance of such lumber yard or place; and such written consents shall accompany the application for a license made by such person or corporation.

Sec. 655. (**Lumber Not to Be Piled Near Planing Mills, Woodworking Establishments or Private Residences.**)

Amended by ordinance of January 2, 1907, to read as follows:

No lumber shall be piled for the purpose of storage, seasoning or drying the same, within fifty feet of any planing mill or wood working manufactory, nor within one hundred feet of any private residence, unless the same has been erected since the establishment of such yard.

Sec. 656. (**Grand Stands.—Frame.—Within the Fire Limits.—Frontage Consents.**)—Wooden grand stands or tiers of seats commonly known and described as grand stands, may be erected within the fire limits where no part of any such structure shall be within sixty feet of any other building or structure, provided that the person or corporation desiring a permit for the construction of such a grand stand shall first obtain the consent in writing of the owners of a majority of the frontage on both sides of the street or streets on each side of the block or square in which it is desired to erect such grand stand.

Sec. 657. (**Ice Houses.**)—Amended March 19, 1906, to read as follows:

Houses to be used exclusively for the storage of ice may be constructed within the fire limits of wood with incombustible roofing, the walls to be inclosed with an envelope of incombustible material: eight-inch brick or tile or approved cement concrete walls, with proper foundations of masonry, shall be used for such envelopes, and such houses shall be used for no other purposes than the storage of ice.

Provided, however, houses to be used exclusively for the storage of ice, may be erected and maintained contiguous with any lake, and six hundred feet from any other building, except buildings used in connection with the conduct of said business, outside of the fire limits, may be constructed of frame, with incombustible roofing, and may have a floor area of not to exceed 80,000 square feet.

Houses to be used exclusively for the storage of ice may be constructed of frame, with incombustible roofing, outside of the fire limits, of greater floor area than 80,000 square feet, provided that building is divided by a solid wall of masonry for each additional 80,000 square feet of floor area, or fractional part thereof, said wall to be approved by the Building Department, and to extend one foot beyond the enclosure of said building on each end.

Houses to be used exclusively for the storage of ice, built contiguous with railroad tracks, and not within one hundred feet of any other building, outside of the fire limits, may be constructed of frame, with incombustible roofing, with a floor area of not to exceed 5,000 square feet.

Houses to be used exclusively for the storage of ice, contiguous with railroad tracks and not within one hundred feet of any other building, outside the fire limits, may be constructed of frame, with incombustible roofing, of a larger area than 5,000 square feet, provided that building is divided by a solid wall of masonry for each additional 5,000 feet of floor area, or fractional part thereof, said wall to be approved by the Building Department, and to extend at least one foot beyond the enclosure of said building on each end.

All dividing walls must extend through and above the roof of any building in which they are built to a distance of three feet and must be covered with incombustible coping. No dividing wall shall be of less thickness than 12 inches at any point thereof.

ARTICLE XVIII.

ELEVATORS AND HOISTWAYS.

Sec. 658. (Elevators, Passenger and Freight.—Permit for Construction.—Fee.)—Before proceeding with the construction of any passenger or freight elevator, except such as are hereinafter specially exempted from the provisions of this chapter, there shall be obtained from the Commissioner of Buildings by the owner or agent of the building in which such elevator is to be constructed or by the contractor who is about to construct such elevator a permit for such construction, and it shall be unlawful for any such owner, agent or contractor to permit or allow the construction of any such elevator, or to proceed with, or in or about any of the work of construction of any such elevator until such permit shall first have been obtained. Such permit shall be issued by the Commissioner of Buildings after application shall have been made to him in writing therefor by any such owner, agent or contractor, specifying the number and kind of elevators which it is desired to construct and the location of the building or structure in which the same is or are to be placed, such application shall be accompanied with such plans and specifications as may be necessary to advise and inform said Commissioner of the plan of construction, type of elevator and location thereof. If such plans and specifications shall show that such elevator or elevators is or are to be constructed or erected in conformity with the provisions of this chapter, the Commissioner shall approve the same and shall issue a permit to such applicant upon the payment by such applicant of a fee of two dollars for each elevator to be constructed and erected, and such fee shall be known as a construction fee, and shall not be held to cover the cost of any inspection which shall at any time thereafter be made of such elevator or elevators when constructed or any of the equipment thereof.

Any person, either as owner or agent of any building or structure in which any elevator or elevators is or are to be constructed, or any contractor engaged in erecting or constructing such elevator or elevators, who shall allow to be erected or constructed, or who shall attempt to erect or construct any elevator or elevators in any building or structure, without having previously obtained the permit herein required, and without having complied with the provisions of this section, shall be fined not less than fifty nor more than two hundred dollars for each offense.

Sec. 659. (Testing of Safety Devices.)—Every passenger or freight elevator hereafter constructed (except such as are hereinafter excepted from the provisions of this chapter) in any building within the city shall be provided with some efficient device to secure the safe operation of such passenger or freight elevator in its running up or down, and such device shall be subjected to such practical test as may be determined by the Commissioner of Buildings to ascertain the efficiency of such safety device to properly perform the service for which it is intended; and it shall be the duty of the Commissioner of Buildings to cause to be made such test of each and every device upon any such elevator hereafter constructed, and no such elevator hereafter constructed shall be permitted to run until the inspection herein provided for has been made and a certificate issued by the Commissioner of Buildings or such inspector that the same has been inspected, and the certificate shall be posted in a conspicuous place in such elevator. Every passenger or freight elevator now in operation within the city shall be provided with some efficient device to procure the safe operation of such passenger or freight elevator in its running up and down, and such device shall be subjected to the same test as is herein provided for elevators to be hereafter constructed, and a certificate of such inspection issued as provided for elevators to be hereafter constructed, and every such elevator now in operation within the city, or which may hereafter be constructed and operated in the city, shall be inspected under and by authority of the Commissioner of Buildings at least once every six months. Every owner or agent of any building who fails to comply with any provision of this section shall be fined not less than fifty dollars nor more than two hundred dollars for each offense, and every owner or agent of any building wherein

any passenger or freight elevators are situated in the city who refuses to permit the inspection of any such elevator or who refuses to permit the making of the test in this section provided, shall be fined not less than twenty-five dollars nor more than two hundred dollars for each and every day on which such elevator runs or is operated on and after the date of the refusal to permit inspection of such elevator or the refusal to allow such test to be made.

Sec. 660. (Safety Devices.—Further.)—Every passenger or freight elevator now running or operating within the city, or which may hereafter be constructed and run and operated, shall be provided with some efficient device for the purpose of preventing the cab or car of such elevator from falling, or the securing of the safety of the cab or car and its load, in case it does fall, and all such devices that are applied to such passenger or freight elevator for the purpose of preventing such cab or car from falling or for stopping it in case it does fall shall be subjected to a practical test, such test to be made under the supervision of the Commissioner of Buildings, to determine the efficiency of such device and to secure the safety of the cab or car and its contents. Every person, whether owner or agent of any building wherein any such passenger or freight elevator within the city is now run or operated, or which may hereafter be constructed or operated, who shall fail or neglect to provide such passenger or freight elevator with such device for the purpose of preventing the cab or car from falling, or the securing of the safety of the cab or car in case it does fall, shall be fined not less than twenty-five dollars nor more than two hundred dollars for each and every day on which such elevator is run or operated without being provided with such device.

Sec. 661. (Tests.—Owner Must Permit.)—Any owner or agent of any building wherein any passenger or freight elevator is run or operated within the city who desires to have a test made by and under the authority of the Commissioner of Buildings as to whether such elevator is provided with sufficient and proper safety devices shall or may notify said Commissioner of Buildings in writing that such a test is desired; and the time when such test may be made, which shall not be less than two nor more than ten days after such notice is given to the Commissioner of Buildings; and it shall be the duty of every owner or agent of any such building wherein any such passenger or freight elevator is run or operated in the city, or which may hereafter be constructed and operated, to permit the making of the test of such devices upon demand being made by the Commissioner of Buildings or by a duly authorized inspector, and every owner or agent of any such building wherein any such passenger or freight elevator is run or operated, or which may be hereafter constructed and operated, who refuses to permit the test of such devices to be made upon demand of said Commissioner of Buildings or Elevator Inspector, within five days from and after such demand is made, shall be fined not less than twenty-five dollars nor more than two hundred dollars for each and every day on which such passenger or freight elevator is run or operated after such demand for and refusal of the making of such test.

Sec. 662. (Certificate to Be Furnished and Posted.)—Whenever any such elevator shall have been inspected and the tests herein required shall have been made of all safety devices with which such elevator is required to be equipped, if the result of such inspection and tests shall show such elevator to be in good condition, satisfactory to the Commissioner of Buildings or the Inspector of Elevators, and that such safety devices have been provided, in accordance with the requirements of this chapter, and are in good working condition and in good repair, it shall be the duty of the Commissioner of Buildings or Inspector of Elevators to issue or cause to be issued, upon the payment of the inspection fee required by the provisions of this chapter, a certificate setting forth the result of such inspection and tests, and whether such elevator and its equipment is in safe condition and in good working order. Such certificates shall be furnished to the owner or agent of the building wherein such elevator is operated, and shall be posted by such owner or agent in a conspicuous place in such elevator.

If the result of such inspection or tests shall show such elevator not to be in safe condition or not to be in a condition of good repair, or shall show that such devices, or any of them, have not been furnished, or, if furnished, are not in good working order or in a good condition of repair, such certificate shall not be issued until such elevator and its equipment or such safety device or devices shall have been put in good working order and in a good condition of repair, satisfactory to the Commissioner of Buildings or the Inspector of Elevators.

In any event, however, the inspection fees herein required shall be paid either at the time application is made for inspection or upon the completion of such inspection and tests.

Sec. 663. (Tests to Be Made Semi-annually.)—It shall be the duty of the Commissioner of Buildings to cause the tests to be made as provided for in Sections 659, 660 and 661 of this chapter of each passenger and freight elevator in the city at least once in every six months from and after the issuance of the first certificate.

Sec. 664. (Inspectors.—Duties Of.—Power of Commissioner to Shut Down Elevators.)—Whenever any inspector of any passenger or freight elevator finds any of the running parts or automatic devices, or other equipment out of order or in an unsafe condition he shall immediately report the same to the Commissioner of Buildings, together with a statement of all the facts relating to the condition of such elevator or elevators.

It shall be the duty of the Commissioner of Buildings, upon receiving a report from any inspector of the unsafe condition of any elevator, to order and cause such elevator to be stopped from use until the same shall have been placed in a safe condition, and any owner or agent of any building wherein any such passenger or freight elevator is run or operated within the city who permits or allows any such elevator to run after the receipt of a notice, in writing, from the Commissioner of Buildings that any such elevator is out of order, or is in an unsafe condition, shall be fined not less than twenty-five dollars nor more than two hundred dollars for each and every day on which such elevator is run or operated without being put in a safe condition or placed in good order.

Sec. 665. (Device.—Efficient.—To Be Approved.)—Any device which shall prove efficient for the purposes hereinbefore described in this chapter shall be approved by the Commissioner of Buildings, if, after a test by said Commissioner or any of his Elevator Inspectors, it is found that such device or devices satisfactorily performs the work it is intended should be performed by such device or devices in and by the provisions of this chapter.

Sec. 666. (Inspections to Be Made at the Same Time.—One Fee.)—All certificates for and inspections of hoistways and elevators provided for in this article shall be made at the same time and the fee required to be paid by Section 668 of this chapter shall include the cost of all such inspections and issuance of such certificates.

Sec. 667. (Elevators Not Required to Be Equipped with Safety Devices.)—The provisions of this chapter requiring the equipment of elevators with safety devices shall not apply to any elevator or elevators in any private residence not more than three stories in height, nor to any hand hoists, elevator or hoist used solely for hoisting materials or tools in any building in course of construction.

For the purposes of this section, flat or apartment buildings shall not be held to be private residences, and any elevator or elevators operated in such flat or apartment buildings shall be equipped with safety devices in accordance with the provisions of this chapter.

Sec. 668. (Inspections.—Fees.)—The owners, agents or occupants of any building in which an elevator is used shall pay to the City Collector, before a certificate of inspection is issued, a fee of two dollars for each inspection of each elevator made in pursuance of the provisions of this chapter.

Sec. 669. (Certificates of Inspection.—Construction.—Details Of.)—When an inspector finds a hoistway, door, shaft and elevator and its equipment, including safety devices, in a sound and safe condition, he shall make and deliver to the owner, or to his agent, a certificate signed by the Commissioner, which shall contain the date of inspection, the condition of the elevator at that date, the weight it may safely carry, and a statement that the shaft, doors and all equipments, including safety devices, are constructed in a safe and proper manner and are constructed in accordance with the provisions of this chapter, which certificate shall be by the owner of the elevator framed and put in some conspicuous place in such elevator for examination by the public; provided, that the words "safe condition" in this section shall mean that it is safe for any load up to the amount of weight named in such certificate.

Sec. 670. (Hatch.—Doors.—Freight Elevators.)—It shall be lawful for elevators used exclusively as freight elevators to be without inclosing walls, but in all such cases there shall be at every floor through which such freight elevators pass automatic hatch closers or automatic doors, made in such manner that they will fully close each well hole when the temperature in such well hole exceeds one hundred and forty degrees Fahrenheit; and it shall be the duty of the owner, agent or person in possession, charge or control of the building in which such elevator or elevators is or are maintained to keep such hatch closers or doors at all times in good working order, and any such owner, agent or person failing to do so shall be fined not less than twenty-five dollars nor more than two hundred dollars for each offense.

Before any doors shall be considered as complying with the provisions of this section they shall be examined by the Commissioner of Buildings and the Fire Marshal, and if it be found by such officials that such doors will automatically close when the temperature at or near the same exceeds one hundred and forty degrees Fahrenheit, and that also the conditions of construction and operation of such doors or hatch closers are such that there is no reasonable probability of their getting out of order and failing to operate when required, and if there is nothing in their construction or operation that is likely to cause accidents to or interference with the elevator service in the hatch holes which they are intended to close, then, and in such case only, shall the use of such hatch closers or doors be permitted.

But such automatic hatch closers or doors shall only be permitted in cases where the building in which such freight elevator is in use shall be equipped with stairways, or stairways and passenger elevators, sufficient to afford ample means of escape from such building in case of fire for all persons employed or for all persons in such building, and in buildings not so equipped such freight elevators shall be inclosed in fireproof walls, as hereinafter required.

Provided, that all freight elevators herein specified shall be either inclosed in fireproof walls, as hereinafter required, or equipped with automatic hatch closers or doors, as herein specified; and provided, further, that this section shall not apply to elevators in fireproof buildings.

Sec. 671. (Passenger and Freight Elevators.—Inclosure Of.)—In all non-fireproof buildings all passenger elevators and all freight elevators, except such as are expressly excepted by this chapter, shall be inclosed in a wall of brick, tile or such other incombustible material as may, from time to time, be approved by the Commissioner of Buildings as proper and suitable for the purpose; such wall to extend from the foundation to the roof of such building, and when built of brick or tile to be entirely self-sustaining; provided, that where such elevator shafts are placed within walls or partitions of fireproof material surrounding such shafts in common with stairways, or in common with stairways and corridors, additional inclosures about such shafts alone shall not be required. Provided, further, however, that the provisions of this section shall not apply to any non-fireproof building which is equipped throughout on every floor and in every room thereof and in all stairways, platforms, elevator shafts, elevator hoistways and well holes with an automatic sprinkler system approved by the Fire Marshal.

Sec. 672. (Doors.—On Elevators.)—In all elevator shafts which are herein required to be inclosed with fireproof walls, the openings through which ingress and egress to and from such elevators is had, shall be equipped with fireproof doors, of iron or other incombustible material, to be approved by the Building Commissioner, which shall be made to open from the inside, except that they shall also be made to open from the outside by means of a key or other device satisfactory to the said Commissioner.

Sec. 673. (Skylights.—Over Elevators.—Windows.)—The roof of each such passenger elevator, shaft or inclosure shall be formed by a skylight, and passenger elevators shall have a ventilator of at least one-twentieth of the area of the shaft, which shall have an operating device which shall be operative from every floor. Skylights may be omitted in shafts wherein there are windows opening on streets, alleys or courts or other vacant spaces, which will permit sufficient light and air, but such windows shall be glazed with fire-resisting glass.

The foregoing provisions relating to elevators and hoistways shall apply to buildings now existing or hereafter constructed.

Sec. 674. (Safety of Employees.—Provisions For.)—In every factory, workshop, or other place or structure where machinery is employed, the belting, shafting, gearing, elevators and every other portion of machinery, when so located as to endanger the lives and limbs of those employed therein while in the discharge of their duties, shall be, as far as possible, so covered or guarded as to make them reasonably safe and to prevent injury to such employees.

ARTICLE XIX.

FIRE ESCAPES AND STANDPIPES.

Sec. 675. (Buildings Required to Have Fire Escapes and Standpipes.—Inspection.—Fee.)—All buildings of four or more stories in height, in the city, except buildings used exclusively for private residences having two flights of stairs leading from the ground floor to the top floor of the building, shall be provided and equipped with one or more metallic standpipes and ladders combined, or stair fire escapes, as described in Section 683 of this chapter, with wrought-iron or steel balconies, with

suitable railings at each floor, and firmly secured to the outer walls, and in such locations and numbers as shall be satisfactory to the Commissioner of Buildings, the Fire Marshal and the fire-escape inspector.

All such fire escapes shall be put up and completed to conform to the buildings for which they are respectively intended, and shall be inspected after completion, and if found in a perfectly safe and satisfactory condition, a certificate shall be issued by the Commissioner of Buildings to that effect, to the owner, agent or occupant of any such building, upon payment to the city collector of a fee of one dollar.

Sec. 676. (Specifications for Ladder Fire Escapes.—Anchors.)—All single and double fire escapes, with ladders, hereafter erected, shall be in strict accordance with the following specifications:

There shall be no less than three one-inch square wrought-iron anchors to every six-foot balcony, and six for a twelve-foot balcony. Such anchors shall pass through the wall of building and bolt on the inside with a three-fourths by two inch nut and three and one-half inch iron washer back of nut, where the wall is not over twenty inches thick; but where wall is over twenty inches thick, anchors shall be inserted at least eight inches into the wall on an angle of thirty-five degrees.

The brace of anchors shall at least be twenty inches spread, and pass into the wall four inches at bottom. No other form of anchors shall be allowed without a special permit from the Commissioner of Buildings.

Sec. 677. (Balconies.)—All balconies hereafter erected shall be either steel or wrought iron, capable of sustaining a weight of five hundred pounds to the square foot. The balcony frame shall be made of not less than one and one-half by three inch angle iron, securely riveted together, with crossbars every two feet, such bars to be punched one-half inch square every two inches center, and one-half inch square iron forced through the same, leaving a manhole of not less than twenty-four by twenty-four inches. The crossbars shall be securely riveted to the angle iron frame. The crossbars for a balcony twenty-eight inches wide shall be one and one-half by three-eighths inch iron. Balcony frames over twenty-eight inches wide shall be made of not less than two by three-eighths inch iron to conform with the increased dimensions of iron in crossbars; for thirty-inch balcony, two by three-eighths inch; for thirty-six inch balcony or over, two and one-half by three-eighths inch. All balconies over this width shall have a two-inch "T" iron through the center of balcony for the bars to rest upon. Such balconies shall have a substantial cast or wrought iron post every three feet, bolted to the balcony. No balcony shall have less than two guard rails, which shall be of wrought iron, or new pipe not less than three-fourths inches in diameter, and the ends shall be anchored in the wall of building not less than ten inches on an angle of thirty-five degrees.

Sec. 678. (Ladders.)—The ladder, where used in combination with the standpipe, shall be bolted to such standpipe with short tapped bolts every four feet and bolted to the balconies. Rungs of ladder shall be one-half inch square iron, with the corners upward, so as to give a safe footing. Every other run shall be riveted and shall be fourteen-inch centers. Where a ladder is put up without a standpipe, the side guards shall be two by three-eighths inch flat iron or one and one-fourth inch pipe. All ladders shall be seventeen inches or more between pipes. No second-hand pipe shall be used.

Sec. 679. (Standpipes Outside Buildings.)—The standpipe shall be of the best three-inch wrought iron, seven and one-half pounds to the foot, and a two and one-half inch brass hose valve, of the city standard thread, shall be attached to the standpipe at every outlet at each floor and on the roof.

Provided, that stand-pipes will not be required on the outside buildings of Classes II, and III, and VI, of less than five stories in height.

As amended by ordinance of October 22, 1906.

Sec. 680. (Standpipes Inside Buildings.—Hotels and Lodging Houses Over Three Stories to Have.—Location and Maintenance of, Subject to Approval by Fire Marshal.—Penalty.)—As amended by ordinance March 19, 1906, to read as follows:

(1) In every building over one hundred (100) feet in height not provided with a three (3) inch or larger inside standpipe; in all buildings hereafter constructed of a greater height than seventy-five (75) feet (except buildings used for theater purposes, as herein elsewhere provided for); in all buildings used for hospital purposes of a greater height than three (3) stories, with accommodations for at least twenty (20) patients; and in all buildings of a greater height than five (5) stories now or hereafter used for hotel or public lodging house purposes there shall be constructed one (1) or more four (4) inch standpipes, which shall extend from basement to roof, and which shall be connected at street or alley side of building with two-way Siamese connection for use of fire department, and which shall be provided with one hose connection with fire department thread, on the roof of said building, on each floor and in the basement thereof, with sufficient hose

attached to reach any point thereof. The pattern, quality, installation and maintenance of such standpipe, hose and couplings, shall be subject to the approval of the Fire Marshal.

(2) In any of the buildings herein referred to where approved sprinkler systems are installed and properly maintained, it shall not be necessary to install additional inside standpipe as above provided for.

(3) On each floor and in the basement of every building used for hotel, public lodging, hospital or school purposes, three or more stories in height, on each floor of all apartment buildings over three (3) stories in height, the floors of which are divided into two or more apartments; on each floor of all office buildings, four (4) or more stories in height, the floors of which exceed two thousand (2,000) square feet in area; on each floor of all mercantile buildings three (3) or more stories in height, having a floor area of two thousand (2,000) or more square feet which is not equipped with approved wet sprinkler system, standpipe and hose, there shall be provided two (2) or more portable hand-pumps, or chemical extinguishers, one or more fire axes, and one or more pike poles, all of which shall be installed and maintained subject to the approval and supervision of the Fire Marshal.

(4) The interior of all grain elevators and malt houses of a height of fifty (50) or more feet, which are not entirely fireproof, and which have a capacity of two hundred and fifty thousand (250,000) bushels or over, and the interior of all cold storage houses of a height of four (4) or more stories, which are not entirely fireproof and which have a ground floor area of ten thousand (10,000) or more square feet, shall be equipped with either a dry or wet sprinkler system, to each of which systems there shall be a feeder or riser pipe or pipes not less than four (4) inches in diameter, leading from one or more Siamese steamer connections; all of which shall be installed and maintained subject to the approval of the Fire Marshal.

(5) Grain elevators which are equipped with Journal Fire Alarm Systems of the most approved pattern and which are left at all times in the most perfect working order, or grain elevators, malt houses and cold storage houses, which are not equipped with standpipes of approved pattern and hose, with not less than two (2) inch connections, which have been installed in accordance with city ordinances and approved by the Fire Department, each floor of which is approved by said department as being at all times easily accessible to firemen, where fire extinguishers, water barrels and pails are distributed at intervals on all floors, on advice and instruction of the Chicago Underwriters' Association; where the necessary pump pressure is maintained; where some approved electric watch service and fire alarm system is maintained and watchmen are employed during nights, Sundays and holidays, pulling such stations not less frequently than once per hour, and which have outside Siamese connections and standpipes not less than two and one-half (2 1-2) inches, shall be exempt from the provisions of this ordinance.

Sec. 681. (Siamese).—There shall be a two-way automatic siamese at the bottom of each standpipe, so that two steam fire engines may be attached to it without interfering with each other. Such siamese shall be within easy reaching distance from the sidewalk and be securely anchored to the wall of the building.

Sec. 682. (Anchors for Top of Standpipe.—Painting).—All the anchors for the top of standpipe and ladders shall pass through the wall and bolt on the inside of same.

All work shall be painted with two coats of the best mineral paint, and all holes shall be filled up with the best cement.

Sec. 683. (Stairway Fire Escapes.—Erection of.—Location.—Component Parts).—The Commissioner of Buildings or fire escape inspector shall determine upon the location of all stair fire escapes before erection of same is commenced.

A permit shall be obtained from the Department of Buildings before work is commenced, which permit will be issued on payment to the city collector of a fee of two (\$2) dollars.

No permit for a stairway fire escape projecting three feet or more from the face of the wall shall be granted unless a detailed plan for the fire escape, approved by a licensed architect or practicing structural engineer, is submitted to the Commissioner of Buildings, and a copy of such plans shall be left on file with said commissioner.

(Anchors).—All anchors for stairway fire escapes shall, wherever possible, pass through the wall of building and be secured on inside of same. Where it is impossible to anchor through walls, anchors shall be put in wall not less than fifteen inches at an angle of thirty-five degrees. On buildings of steel construction, where walls are less than twenty inches in thickness, there shall be steel channels at least four inches wide set on inside of building from column to column and bolted or riveted to columns, and anchors shall be bolted on inside of channels.

Anchors for a platform four feet two inches or less in width shall be made of one-inch square iron; over four feet two inches and not over six feet, shall be one and one-fourth inch square iron, with brace; over six feet, shall be one and one-half inch square iron, with brace. All anchors shall be turned up not less than six inches at the outside of platform to bolt post to.

(**Braces.**)—Braces shall be the same thickness as the anchors. Spread of braces shall be the width of platform. Where the platforms are over five feet in width, anchors shall have double braces, one to the outside and one to the center of platform.

(**Platforms.**)—Platforms shall be not less than fifty inches wide at ends; passageways shall be not less than twenty-four inches between building and railings. Platforms shall be not less than twelve feet in length. The frames and crossbars shall be made as specified by Section 677 of this chapter. Platforms shall have clips at each end bolted to anchors. No door or window or shutter shall open so as to obstruct in any way the free passage on or along a platform or a staircase or ladder fire escape.

(**Stairs.**)—All fire escape stairs for apartment buildings, hotels, boarding houses, factories and office buildings, where there are less than one hundred people, shall be not less than two feet wide between railings and stringers. Where there are more than one hundred people, stairs shall be three feet wide. All stairs for halls, churches, theaters, hospitals, schools, department stores and buildings where large numbers of people congregate shall be not less than three feet wide in the clear, and all passageways shall be not less than three feet wide in the clear; stringers shall be made of two bars three by five-sixteenths inch, about one inch apart, or four and one-half by three-eighths inch flat iron. Where over twelve feet in length, they shall have anchor and brace in center. The treads shall be made of one-half inch square steel or iron, corner upwards not to exceed one and five-eighths inches center, riveted at ends to two by five-sixteenths inch flat iron or steel. There shall be not less than four bars to a tread, where treads are less than twenty-seven inches in length; where treads are over twenty-seven inches in length, there shall be not less than six bars to a tread; then, there shall be a truss supporting treads made of bar iron two inches by three-eighths of an inch, riveted to bars of treads in center, supported by two seven-sixteenth inch rods bolted at each end of treads. All stairs shall have an incline of about forty-five degrees; rise of treads shall be not less than seven inches and not more than ten inches.

(**Railings.**)—All stairs shall have three bar railings made of one-inch bar iron for top rail and three-quarter inch bar iron for lower rail, and when such stairs are more than three inches from wall of building, then there shall be one or more hand rails on the wall side of such stairs.

(**Posts.**)—All posts used for stair fire escapes shall be made of one and one-half inch angle or channel iron not less than three feet six inches high, and shall have braces on outside turned upwards and fastened to frame of balcony or stairs and not less than half way up the post; all stair fire escapes shall extend to the ground, either by counterbalance or drop stairs. Cables for counterbalance stairs shall be not less than three-quarters inch in size, and shall be well oiled or greased when hung up, and oiled or greased at least once a year. All pulleys and cables holding counterbalance shall be covered at bracket, so as to protect it from snow or ice.

(**Painting.**)—All stair fire escapes shall be painted with two coats of paint, one at the shop and one after completion at the building.

Where it is impossible to erect stair fire escapes according to these specifications, then plans shall be submitted to the Commissioner of Buildings or fire escape inspector for approval.

All such fire escapes shall, on completion, be inspected by the fire escape inspector, and if found safe and satisfactory, a certificate will be issued upon payment of one (\$1) dollar to the city collector.

Sec. 684. (**Fire Escapes in General.**)—No fire escape of any kind shall be constructed except upon a permit therefor issued by the Commissioner of Buildings upon the payment by the applicant therefor to the city collector of a permit fee of two dollars.

Every building in the city required by law to be equipped with metallic stand-pipes and wrought iron or steel balconies, or other fire escape devices, shall have displayed in conspicuous places, on each floor of such building, notices sufficient in number and in plainly legible type at least six inches in height, indicating and showing the location of such metallic ladders, balconies and fire escapes and the easiest way to reach them. If such notices be not displayed within thirty days after such equipment and kept continuously displayed, said commissioner is authorized to take such action as may be necessary to have such building closed.

Sec. 685. (**Penalty.**)—Any owner, agent or person in possession, charge or control of any such building, who violates, disobeys, omits or neglects to comply with the terms of the foregoing section, shall be fined not less than five dollars nor more than fifty dollars for each offense, and every such owner, agent or person shall be deemed guilty of a separate offense for every day such violation, disobedience, omission or neglect shall continue, and shall be subject to the penalty imposed hereby for each and every such separate offense.

Where stair fire escapes pass windows or doors, the windows or doors shall be of fire-resisting glass and have metal frames and sash, or such fire escapes shall be hooded with metal for at least two feet each side of such opening.

ARTICLE XX.

FIRE LIMITS.

As defined by ordinance passed February 11, 1907.

Sec. 686. (**Fire Limits of City.**)—The fire limits of the City of Chicago shall be and are hereby defined as follows: All that part of the City of Chicago bounded by the following limits: Commencing at the intersection of the shore of Lake Michigan and a line one hundred and fifty feet north of the center line of Belmont avenue, thence west on said first mentioned line to the center line of North Halsted street, thence south along said center line of North Halsted street to the center line of Fullerton avenue, thence west along said center line of Fullerton avenue to the center of the North Branch of the Chicago River, thence northwesterly along the center of said North Branch of the Chicago River to the center line of Belmont avenue, thence west along said center line of Belmont avenue to the center line of Kedzie avenue, thence south along said center line of Kedzie avenue to the center line of West North avenue, thence west along said center line of West North avenue to the center line of North Fortieth avenue, thence south along said center line of North Fortieth avenue to the center line of the first alley north of Park avenue, thence west along the center line of said alley to the center line of South Forty-sixth avenue, thence south along said center line of South Forty-sixth avenue to the center line of West Madison street, thence west along the center line of West Madison street to the center line of South Forty-eighth avenue, thence north along said center line of South Forty-eighth avenue to the center line of Kinzie street, thence west along said center line of Kinzie street to the center line of South Fifty-second avenue, thence south along said center line of South Fifty-second avenue to the center line of West Madison street, thence east along said center line of West Madison street to the center line of South Fiftieth avenue, thence south along said center line of South Fiftieth avenue to the north line of the present right of way of the Chicago & Great Western Railroad Company, thence east along the said north line of said right of way to the center line of South Forty-eighth avenue, thence south along the said center line of South Forty-eighth avenue to the center line of West Twelfth street, thence east along said center line of West Twelfth street to the center line of South Forty-sixth avenue, thence south along said center line of South Forty-sixth avenue to the center line of West Twenty-second street, thence east along said center line of West Twenty-second street to the center line of South Fortieth avenue; thence south along said center line of South Fortieth avenue to the center line of the Illinois and Michigan Canal, thence northeasterly along the center line of the said canal to the center line of South Western avenue; thence south along said center line of South Western avenue to the center line of West Thirty-ninth street, thence east along said center line of West Thirty-ninth street to the center line of State street, thence south along said center line of State street to the north line of West Forty-seventh street, thence west along said north line of West Forty-seventh street to a line seventy-five feet west of the west line of South Halsted street, thence south to a line seventy-five feet north of the west line of South Halsted street along said line seventy-five feet west of the north line of West Sixty-third street, thence west along said line seventy-five feet north of the north line of West Sixty-third street to the center line of South Ashland avenue, thence south along the center line of South Ashland avenue to the center line of West Sixty-third street, thence east along said center line of West Sixty-third street to the center line of State street, thence south along said center line of State street to the center line of East Seventy-fifth street, thence east along said center line of East Seventy-fifth street to the shore of Lake Michigan, thence northerly and northwesterly along the shore of Lake Michigan to the place of beginning.

Also, commencing at a point in the center of Manistee avenue, where it intersects the right of way of the main line of the Lake Shore & Michigan Southern Railroad; thence northeasterly and north along the center line of Manistee avenue to the center line of Eighty-ninth street, thence east along the center line of Eighty-ninth street to the center line of Mackinaw avenue, thence south along the center line of Mackinaw avenue to the center line of Harbor avenue, thence southwesterly along the center line of Harbor avenue to the center line of Ninety-third street; thence west along the center line of Ninety-third street to the easterly line of the Baltimore & Ohio railroad right of way; thence south along the easterly line of the Baltimore &

Ohio railroad right of way and Baltimore & Ohio railroad extended, to the north-easterly line of said Lake Shore & Michigan Southern Railroad; thence northwesterly along the northeasterly line of said right of way to the place of beginning.

Sec. 687. (**Fire Limits.—Provisional.**)—Provided, however, that any person desiring to erect a frame or wooden building, to be used for residence or mercantile purposes within that portion of the territory bounded on the east, between Sixty-seventh and Seventy-fifth streets, by Lake Michigan, on the south by the center line of Seventy-fifth street, on the west by the center line of State street to the intersection of Sixty-third street, thence east along the center line of Sixty-third street to the intersection of Cottage Grove avenue, thence south along the center line of Cottage Grove avenue to the intersection of Sixty-seventh street, thence east along the center line of Sixty-seventh street to Lake Michigan, shall have a right to do so, upon presenting a petition to the Commissioner of Buildings, together with a plat, plans and specifications showing the place where such building is to be erected. Such petition shall be verified by the affidavit of the applicant and shall contain the written consent of the owners of a majority of the frontage upon each side of the streets or alleys in the block or square in which the building is to be erected.

No frame or wooden residence or mercantile building shall be erected within the said provisional fire limits exceeding forty feet in height unless the basement story shall be constructed of brick or stone, in which case the height shall not exceed forty-five feet above the sidewalk.

Sec. 688. (**Fire Limits.—Exception From.**)—There shall be excepted from the fire limits as hereinbefore defined, the territory bounded as follows:

Commencing at the intersection of a line seventy-five feet west of the west line of State street and a line seventy-five feet south of the south line of Forty-seventh street, thence west along said line seventy-five feet south of the south line of Forty-seventh street to a line seventy-five feet east of the east line of Wentworth avenue, thence south along said line seventy-five feet east of the east line of Wentworth avenue to a line seventy-five feet north of the north line of Sixty-third street to a line seventy-five feet west of the west line of State street, thence north along said line seventy-five feet west of the west line of State street to the place of beginning.

Also that territory within the lines beginning at the intersection of a line seventy-five feet west of the west line of Wentworth avenue, and a line seventy-five feet south of the south line of Forty-seventh street; thence west along said line seventy-five feet south of the south line of Forty-seventh street to a line seventy-five feet east of the east line of South Halsted street; thence south along said line seventy-five feet north of the north line of South Halsted street to a line seventy-five feet north of the north line of Sixty-third street; thence east along said line seventy-five feet north of the north line of Sixty-third street to a line seventy-five feet west of the west line of Wentworth avenue; thence north along said line seventy-five feet west of the west line of Wentworth avenue to the place of beginning.

As amended by ordinance of February 26, 1906.

ARTICLE XXI.

FRONTAGE CONSENTS.

Sec. 689. (**Definition of Word "Block," as Used in This Chapter.**)—Whenever in this chapter a provision is made that frontage consents shall be obtained for the erection, construction, alteration, enlargement or maintenance of any building or structure in any block, the word "block," so used, shall not be held to mean a square, but shall be held to embrace only that part of a street bounding the square which lies between the two nearest intersecting streets, one on either side of the point at which such building or structure is to be erected, constructed, altered, enlarged or maintained, unless it shall be otherwise specifically provided.

Sec. 690. (**Hospitals.—Permits.—Special Consents.—Height Of.**)—It shall be unlawful for any person or corporation to build, construct, maintain, conduct or manage in any block, if two-thirds of the buildings fronting upon both sides of the streets bounding such block or square are devoted exclusively to residence purposes, any hospital for the care, treatment or nursing of three or more insane persons; or any hospital for the care, treatment or nursing of three or more inebriates, or persons suffering from the effects of the excessive use of alcoholic liquors; or any hospital for the care, treatment or nursing of three or more epileptics; or any hospital for the care, treatment or nursing of three or more persons addicted to, or suffering from, the excessive use of morphine, cocaine or other similar drugs or narcotics; or any hospital for the care, treatment or nursing of any person or persons affected with any infectious or contagious disease, unless the owners of a majority of the frontage in such block and in addition thereto the owners of a majority of the frontage on the opposite sides of the streets bounding

such block consent in writing to the building, constructing or maintaining, managing or conducting of any such hospital in such block. Such written consents of the majorities of such property owners shall be filed with the Commissioner of Buildings, and an exact copy of same shall be filed with the Commissioner of Health before a permit shall be granted for the building or constructing or a license issued for the maintaining, conducting or managing of any such hospital. Provided, that any such building that may be used for such purposes as set forth in this section and which is over two stories in height shall be of fireproof construction throughout, and no hospital shall be built to exceed six stories in height.

Sec. 691. (Hospitals.—Location of Near School Houses.)—Amended by ordinance March 4, 1907, to read as follows:

No hospital of any kind or description hereafter erected or established shall be erected or established on any lot or parcel of ground any part of which is located within four hundred feet by the nearest traveled route of any property used for school purposes.

Sec. 692. (Stables.—Gas Reservoirs.—Blacksmith Shops.—Foundries.—Packing Houses.—Rendering Plants.—Soap Factories.—Tanneries.—Breweries.—Distilleries.—Grain Elevators.—Junk Shops.—Laundries.—Special Consents Necessary.)—It shall not be lawful for any person or corporation to locate, build, construct or maintain, on any street or alley in the city, in any block in which two-thirds of the buildings on both sides of the street are used exclusively for residence purposes, any building for a boarding, livery or sale stable, gas reservoir, blacksmith shop, foundry, packing house, rendering plant, soap factory, tannery, brewery or distillery, grain elevator, junk shop, or laundry to be run by machinery, without the written consent of a majority of the property owners, according to frontage, on both sides of such street or alley.

Such written consent shall be obtained and filed with the Commissioner of Buildings before a permit is issued for the construction of any such building. Provided, that in determining whether two-thirds of the buildings on both sides of the street are used exclusively for residence purposes any building fronting upon another street and located upon a corner lot shall not be considered.

Sec. 693. (Reformatories.—Sheltering Institutions.)—It shall be unlawful for any person or corporation to build, construct, maintain, conduct or manage any reformatory, rescue or sheltering institution in any block or square in which two-thirds of the buildings on both sides of the street or streets on which the proposed reformatory, rescue or sheltering institution may front are used exclusively for residence purposes, without the written consent of a majority of the property owners, according to frontage, on both sides of the streets bounding such block.

Such written consent shall be obtained and filed with the Commissioner of Buildings before a permit is issued for the construction or keeping of such building.

Provided, that in determining whether two-thirds of the buildings on both sides of the street are used exclusively for residence purposes, any building fronting upon another street and located upon a corner lot shall not be considered.

Sec. 694. (Permits for Moving Frame Buildings.—Requirements.—Written Consents Must Be Obtained.—Affidavits Made.)—Permits to move frame buildings shall be granted, if any such frame building has not been damaged to an extent greater than fifty per cent of its original cost, by fire, wear and tear, the action of the elements or otherwise. *Any person desiring to remove a frame building shall first obtain the written consent to such removal from persons owning a majority of the frontage of the lots on both sides of the street in the same block to which the building is to be removed.*

As amended by ordinance of June 5, 1906.

This section shall not apply to the case of any person removing a building upon his own premises and not going upon the premises of any other person, or upon any street, alley or other public place, in making such removal.

Provided, however, that no permit shall be issued for the removal of any frame building from any point outside the fire limits to any point within the fire limits, when such building is of such a character that it would not be lawful to build it within the fire limits.

ARTICLE XXII.

USE AND OBSTRUCTION OF STREETS FOR BUILDING PURPOSES.

Sec. 695. (Sidewalk and Street.—Occupation Of.—Limitations.)—The extent of occupation of sidewalk and street to be covered by the terms of a permit for street obstruction or building shall be as follows:

Such permit shall not authorize the occupation of any sidewalk or street or part thereof other than that immediately in front of the lot or lots upon which any building is in process of erection and in relation to which such permit is issued.

During the progress of building operations a sidewalk not less than four (4) feet in width shall be at all times kept open and unobstructed for the purpose of passage in front of such lot or lots. Such sidewalk shall, if there are excavations on either side of the same, be protected by substantial railings which shall be built and maintained thereon so long as such excavations continue to exist. It is not intended hereby to prohibit the maintenance of a driveway for the delivery of material across such sidewalk from the curb line to the building site.

Sec. 696. (Sidewalks.—Delivery of Material.—Elevated Sidewalks.)—It shall be permitted for the purposes of delivering material to the basements of buildings in process of erection to erect elevated temporary sidewalks to a height of not exceeding four feet above the curb level of the street; and in case a sidewalk is so elevated, it shall be provided with good, substantial steps or easy inclines on both ends of the same and shall have railings on both sides thereof.

Sec. 697. (Sidewalks.—Temporary Roof Over.—Time Maintained.)—If the building to be erected is more than four stories in height, and is set at or near the street line, there shall be built over the adjoining sidewalk a roof having a framework and covering composed of supports and stringers of three by twelve timbers, not more than four feet from centers, covered by two layers of two-inch plank.

Such roof shall be maintained as long as material is being used or handled on such street front and above the level of such sidewalk.

In all cases such temporary sidewalks and their railings and approaches, and the roofs over the same, shall be made, as regards ease of approach, strength and safety, to the satisfaction of the Commissioner of Buildings.

Sec. 698. (Street.—Storage of Building Materials.—Limitations.)—The occupation of the street for the storage of building materials, or for temporary sidewalks, shall never exceed, in front of any one building, one-third of the width of the roadway of the same, and in no event shall any material be stored or placed within four feet of any street or steam railway track.

Sec. 699. (Sidewalks and Street.—Excavated Material and Rubbish On.—How Cared For.)—Earth, other than sand to be used in the construction of the building, taken from excavations, and rubbish taken from buildings shall not be stored either upon sidewalks or roadways of streets, and shall be removed therefrom from day to day as rapidly as produced. When dry rubbish, apt to produce dust, is being handled, it shall be kept wetted down so as to prevent its being blown about by the wind.

Sec. 700. (Derricks.—Limitations.)—For all buildings more than four stories in height, the use of derricks set upon the sidewalk or street is prohibited. In no case shall the guy lines be less than fifteen feet above the roadbed.

Sec. 701. (Frontage Adjacent.—How Occupied for Building Purposes.)—If the written consent and a waiver of claims for damages against the city of the owners of properties abutting upon the site of any proposed building is first obtained and filed with the Commissioner of Public Works, the permission to occupy the roadway and the sidewalk may be extended beyond the limits of such building in front of the property for which the consent of the owner or lessee thereof has been secured, upon the same terms and conditions as those herein fixed for the occupation of sidewalk and street in front of the building site.

Sec. 702. (Street, Use of, for Building Purposes.—When Terminated.)—Streets and sidewalks may be occupied for the purposes of building only in connection with the actual erection, repair, alteration or removal of buildings, and permission for such occupancy shall terminate with the completion of such operation. It shall be unlawful to occupy any sidewalk or street after the completion of the operation for which a permit has been issued by the Department of Buildings. It shall also be unlawful to occupy a sidewalk or street, under authority of such permit, for the storage of articles not intended for immediate use in connection with the operations for which such permit has been issued.

Sec. 703. (Red Lights.)—Red lanterns shall be displayed and maintained during the whole of every night at each end of every pile of material in any street or alley and at each end of every excavation.

Sec. 704. (Street Obstructions.—Permits.—Bonds.—Fees.)—Permits for the obstruction of streets shall be issued by the Commissioner of Public Works and shall be paid for, in proportion to the street frontage occupied, at the rate of two dollars per month for each twenty-five feet of frontage so occupied.

No permit shall be issued until the applicant therefor shall have executed and filed with the Commissioner of Public Works a bond, with sureties to be approved by said Commissioner, and in an amount to be designated by him (in no case to be less than

ten thousand dollars), conditioned to indemnify, save and keep harmless the city from any and all loss, cost, expense or liability of any kind whatsoever which it, the city, may suffer or be put to or which may be recovered from it from or by reason of the issuance of such permit, or by reason of any act or thing done under or by virtue of the authority given in such permit.

ARTICLE XXIII.

BILLBOARDS AND SIGNS.

This entire article amended by ordinance of January 2, 1907, together with a new section, to be known as Section 706 a, added.

Sec. 705. (Billboards or Signboards on Buildings.)—Every billboard of greater height than two feet and placed on any building shall be faced with iron or other incombustible material with framework of wood or iron, and shall be securely anchored and fastened to such building in such manner as to make the same safe, to the satisfaction and approval of the Commissioner of Buildings. When such billboard or signboard is situated above or upon the roof of any building the supports and framework for same may be of wood, and the number of such supports and the construction of same and the construction of the framework for same shall be satisfactory to and approved by the said Commissioner.

No billboard or signboard anchored to, fastened to, or situated above or upon the roof of any building shall be placed so that the face of same shall come within three feet of the inner plane of the outer wall of such building, nor shall the same be constructed so that the bottom of such billboard or signboard shall be less than one foot or more than three feet above the surface of such roof; the face of such billboard or signboard shall not exceed ten feet in height, nor shall it exceed twenty-four feet in length for every twenty-five feet of frontage on the building on which it is placed, nor extend beyond the wall of said building; and such billboard or signboard shall have a door in the center of same which can be readily opened and which when so opened will leave a clear space at least four feet in width and seven feet in height from the roof to the top of said door.

No billboard or signboard shall be anchored to, fastened to or situated above or upon the roof of any building more than two (2) stories in height; and no billboard or signboard shall be anchored to, fastened to or situated above or upon the roof of any building having other than a flat roof.

No billboard or signboard such as is described in this section, whether anchored to or fastened to any building or situated or located upon the roof thereof, shall be constructed and put in place unless in accordance with plans and specifications which have been submitted to and approved by the Commissioner of Buildings.

Sec. 706. (Size and Construction of Billboards and Signboards Erected Within Fire Limits Otherwise Than on Buildings.)—No billboards or signboards erected within the fire limits as now defined or as they may hereafter be defined by ordinances of the City (other than signboards and billboards referred to in Sections 705 and 707 hereof) shall exceed twelve (12) feet in height, and the same shall be constructed of tin or galvanized iron or some other equally incombustible material, except that the stringers, uprights and braces thereof may be made of wood. All such billboards or signboards shall be securely anchored or fastened so as to be safe and substantial.

Sec. 706 a. (Height and Distance From Ground of Billboard or Signboard Erected Within Fire Limits.)—No billboard or signboard (other than those referred to in Sections 705 and 707 hereof) shall be constructed within the fire limits at a greater height than seventeen feet above the level of the adjoining street, and the base of the billboard or signboard shall be in all cases at least five feet above the level of the adjoining street, and in case the surface of the ground upon which such billboard or signboard is erected is above the grade of the adjoining street, the base of such billboard or signboard shall be not less than two feet above the surface of the ground. In case the grade of the adjoining street or streets has not been established, no such billboard or signboard shall be constructed at a greater height than seventeen feet above the level of the street adjoining the ground upon which such billboard or signboard is erected.

Sec. 707. (Wooden Billboards or Signboards.—Construction.—Size.—Exceptions.)—Billboards or signboards not exceeding twelve square feet in area may be built of wood or other combustible material, and such billboards or signboards shall be exempt from the provisions of this article. Signs erected flat against the face of buildings shall also be exempt from the provisions of this Article, provided that such signs shall be safely and securely fastened to the building.

Sec. 708. (Billboards or Signboards Erected Outside of the Fire Limits.—Construction.—Size.)—All billboards or signboards erected outside of the fire limits as now defined or as they may hereafter be defined by the ordinances of the city (other than those referred to in Sections 705 and 707 hereof) shall comply with the following conditions:

If such billboard or signboard be erected or located so that no part thereof is nearer than ten feet to any building, wooden fence, or other structure, such billboard or signboard may be constructed of wood or other combustible material, but no part of same shall exceed seventeen feet in height, and the same shall be so constructed that there shall be a clear space of not less than five feet between the bottom of such billboard or signboard and the surface of the ground upon which such billboard or signboard is erected. If any part of such billboard or signboard shall be within ten feet of any building, wooden fence, or other structure, the size and construction of such billboard or signboard shall be limited as is provided in Sections 706 and 706a for billboards or signboards erected within the fire limits. All billboards or signboards erected outside of the fire limits as provided for in this section shall be securely anchored or fastened so as to be safe and substantial.

Sec. 709. (No Billboard or Signboard Shall Be Erected Without Permit.)—No billboard or signboard such as is described in this article shall be erected or maintained within the City unless a permit shall first have been secured by the person desiring to erect or maintain such billboard or signboard from the Commissioner of Buildings, to whom application for such permit shall be made; and such application shall be accompanied by such plans and specifications of the proposed billboard or signboard as are necessary to fully advise and acquaint the said Commissioner with the construction of such proposed billboard or signboard. If the plans and specifications accompanying such application shall be in accordance with the provisions of this article, said Commissioner shall thereupon issue a permit for the erection of such billboard or signboard, upon the payment by the applicant of a fee as hereinafter fixed; provided, however, that none of the provisions of this article shall apply to or affect any billboard erected upon land abutting the right-of-way of any railroad where such billboard does not come within twenty-five feet of any public highway and where the bottom of such billboard is not less than three feet from the ground and the same is situated more than fifty feet from any building.

Sec. 710. (Alteration and Repair of Billboards and Signboards.)—No material alteration of any billboard or signboard shall be made except upon a written permit issued by the Commissioner of Buildings authorizing such alteration; and such permit shall be issued upon application in writing made to such Commissioner by the owner of such billboard or signboard or by the person in charge, possession, or control thereof, accompanied by a plan or statement of the proposed alterations to be made; which, if satisfactory to and approved by the Commissioner of Buildings, shall authorize such applicant to receive a permit upon the payment of a fee therefor as hereinafter fixed; but such alteration shall not be construed to apply to the changing of any advertising matter of any billboard or signboard, nor the refacing of the framework supporting same.

Sec. 711. (Billboards Now Existing to be Altered to Comply with the Provisions of this Article.)—Every now existing billboard or signboard, whether erected upon or above the roof of any building or attached or fastened to the wall or walls of any building, or standing upon or erected upon any lot or premises, which is now erected or which is now maintained contrary to the provisions of this article, shall be forthwith removed or altered, changed, or cut down so as to fully comply with such provisions; and any billboard or signboard now existing and not complying with the provisions of this article which shall not have been removed or torn down or so altered and changed within nine months from and after the passage of this ordinance as to be brought into conformity with the provisions of this article by the owner thereof or by the person in charge, possession, or control thereof, shall be torn down by the Commissioner of Buildings and the cost and expense of tearing down such billboard or signboard shall be charged to the owner of such billboard or signboard or the person in charge, possession, or control thereof, and shall be recovered from such person for the use of the city by any appropriate proceeding therefor.

Sec. 712. (Duty of Commissioner.—Owner's Name to be Placed on Top of Billboard.)—It shall be the duty of the Commissioner of Buildings to inspect all plans and specifications submitted in connection with the erection or construction or the alteration or repair of any billboard or signboard and to approve same if the method of construction and provisions made for fastening, securing, anchoring and maintaining such billboards or signboards are such as will serve to protect the public

and to render such billboards or signboards safe and substantial. It is further made the duty of the Commissioner of Buildings to exercise a supervision over all billboards and signboards erected or being maintained under the provisions of this article; and whenever it shall appear to said Commissioner that any such billboard or signboard has been erected in violation of this ordinance or is in an unsafe condition or has become unstable or insecure or in such a condition as to be a menace to the safety of the public, he shall thereupon issue or cause to be issued a notice in writing to the owner of such billboard or signboard or the person in charge, possession or control thereof, if the whereabouts of such person is known, informing such person of the violation of this ordinance and the condition of such billboard or signboard and directing him to make such alterations or repairs thereto or to do such acts or things as are necessary or advisable to place such billboard or signboard in a safe, substantial and secure condition, within such reasonable time as may be stated in said notice. If the person so notified shall refuse, fail, or neglect to comply with and conform to the requirements of such notice, said Commissioner shall, upon the expiration of the time therein mentioned, tear down or cause to be torn down such billboard or signboard, and shall charge the expense of such tearing down to the person so notified. If the owner of such billboard or signboard or the person in charge, possession, or control thereof cannot be found or his whereabouts is not easily ascertainable, the Commissioner shall attach or cause to be attached to such billboard or signboard a notice of the same import as that required to be sent to the owner where such owner is known; and if such billboard or signboard shall not have been made to conform to this ordinance and placed in a secure, safe, and substantial condition, in accordance with the requirements of such notice, within thirty days after such notice shall have been attached to such billboard or signboard, it shall be the duty of the Commissioner of Buildings to thereupon order such billboard or signboard torn down; provided that nothing herein contained shall prevent the Commissioner of Buildings from adopting such precautionary measures as may be necessary or advisable in case of imminent danger in order to place such billboard or signboard in a safe condition, the expense of which may be charged to and recovered from the owner of same in any appropriate proceeding therefor. No permit shall be issued to any applicant for permission to erect a billboard or signboard unless such applicant shall agree to place and maintain on the top of such billboard or signboard the name of the person or corporation owning same or who is in charge, possession, or control thereof. It shall be the duty of the Commissioner of Buildings to see to it that the name of the person or corporation owning or in possession, charge, or control of such billboard or signboard is placed upon such billboard or signboard forthwith upon the erection thereof and is kept thereon at all times while such billboard or signboard is maintained; and in case the owner of such billboard or signboard or the person in charge, possession, or control thereof shall fail or refuse to place and maintain such name on the same after due notice from the Commissioner of Buildings he shall be subject to the penalty hereinafter provided for.

Sec. 713. (**Fees for Permits.**)—The fee to be charged for permits issued for the erection or construction of billboards or signboards or for the alteration thereof shall be two dollars (\$2.00) for each billboard or signboard.

Sec. 714. (**Penalty.**)—Any person or corporation owning, operating, maintaining, or in charge, possession, or control of any billboard or signboard within the city, who shall neglect or refuse to comply with the provisions of this article, or who erects, constructs or maintains any billboard or signboard that does not comply with the provisions of this article, shall be fined not less than twenty-five dollars nor more than two hundred dollars for each offense; and each day on which any such person shall permit or allow any billboard or signboard owned, operated, maintained or controlled by him, to be erected, constructed, or maintained in violation of any of the provisions of this article, shall constitute a separate and distinct offense.

Sec. 715. (**Fences.—Height of.**)—No wooden fences shall be constructed of greater height than eight feet above the sidewalk grade or eight feet above the surface of the ground where no grade is established.

ARTICLE XXIV.

STORAGE OF OILS.

Sec. 716. (**Storage of Oils.—Buildings for Storage of Oils.—Walls.—Roof.—Floor.**)—Buildings designed for the storage of crude petroleum, gasoline, naphtha, benzine, camphine, carbon oil, spirit gas, burning fluid, spirits of turpentine or coal, rock or earth oils (excepting such refined oils as will stand a fire test of one hundred and fifty degrees Fahrenheit according to the method and direction of John Tagliabue), shall be constructed as follows:

The walls shall be of brick, stone, or concrete, and shall be not less than sixteen inches thick or more than sixteen feet high. The lower floor of such buildings shall be at least three feet below the grade of the adjoining street and shall be made of earth, concrete or brick. The roof of such buildings shall be made of tile, metal or other incombustible material, and the outside walls of any such building having a flat roof shall extend at least eighteen inches above the roof. The coping upon the roof of such buildings shall be made of incombustible material. Such buildings shall be detached from all other buildings and shall be properly ventilated. Where any such building shall be located less than twenty-five feet away from any other building or structure, the wall or walls of such building on the side or sides thereof, within such distance of twenty-five feet from any other building or structure shall have no window or other opening therein; provided, however, that if such building cannot be so constructed that no outside wall thereof shall be less than twenty-five feet away from any other building or structure, in such case, openings may be made in the wall of such building which is located farthest away from any other building or structure for the purpose of admitting light or providing means of access thereto or egress therefrom. If such opening be a window, the glass in such window shall be fire-resisting glass, and such window shall be provided with a steel shutter.

No such building shall be occupied for any purpose other than the storage of oils, and no person shall be permitted to use any such building as a sleeping apartment or dwelling place.

The interior cubic capacity of any such building shall exceed by at least twenty-five per cent the total capacity of the tanks or other receptacles placed in such building.

Such buildings and the equipment thereof, including the protection of the doors and windows, shall be constructed according to plans and specifications which have been submitted to and approved by the Commissioner of Buildings.

Sec. 717. (Tanks for Storage of Oils.)—Tanks for the storage of any one or more of the oils or fluids mentioned in the preceding section may be built outside of buildings either above or under the surface of the ground, provided the following specifications are complied with:

Such tanks shall be made of metal of sufficient gauge and tensile strength for the purpose for which they are to be used. All portions of such tanks are to be riveted together and shall be made liquid tight. Every such tank shall have a manhole and shall be equipped with adequate ventilating or safety devices.

All tanks other than those located in buildings constructed under the provisions of Section 716 of this article, whether placed above or below the surface of the ground, shall have no building or structure of any kind whatsoever over or above the same; provided, however, that if any such tank be located near a railroad track or manufactory or place where sparks are likely to fall, and it is desired, in order to obviate such danger, to construct over such tank a shed or shelter, such shed or shelter may be constructed upon a permit in writing therefor being issued by the Commissioner of Buildings; and such permit shall only be issued if it shall be shown that such shed or shelter is necessary and upon the express agreement that such shed or shelter shall be used for no other purpose than affording protection or shelter, and shall not be used for storage, manufacturing, residence, office, or any other purpose whatsoever.

Sec. 718. (Walls Around Tanks.)—Where any such storage tank or any portion thereof is erected or maintained upon or above the surface of the ground and is situated less than fifty feet from any other building or structure other than the buildings or structures upon the premises wherein such oils or fluids are to be used or stored, such tanks shall be separated from any such building or structure by an inclosing wall of brick, stone or concrete; and such wall shall be not less than five feet high and in no case of less height than two feet higher than the top of the tank which it is designed to separate from such building or structure. If such wall be ten feet high or less it shall be not less than twelve inches in thickness, and four inches in thickness shall be added for every additional ten feet or major fraction thereof of height added to such wall. Such wall shall entirely surround or inclose such tank; provided, however, that an opening may be constructed in such inclosing wall to permit access to the tank. Such opening shall contain a liquid-tight door made of incombustible material, either sliding or opening inward, and of sufficient strength to resist any pressure which may be brought to bear on such door by the bursting of the tank inclosed in such wall.

All such tanks and walls described in this section shall be constructed in accordance with plans and specifications which shall have been submitted to and approved by the Commissioner of Buildings.

Sec. 719. (Storage of Petroleum, Etc.)—It shall be unlawful for any person or corporation to keep or store crude petroleum, gasoline, naphtha, benzine, camphine, carbon oil, spirit gas, burning fluid, spirits of turpentine, or coal, rock or earth oil (excepting such refined oils as will stand a fire test of one hundred and fifty degrees Fahrenheit, according to the method and direction of John Tagliabue), upon or in any structure or premises, in any quantity exceeding one barrel of fifty gallons, within the city, except in such a building or such tanks as are hereinbefore described in this article, and where a quantity of any of such oils exceeding five gallons and not exceeding fifty gallons is kept in any premises other than such a building the receptacle or receptacles in which such oils is or are kept shall not be placed under any stairway or in any confined space, but shall be kept in such manner that no vapor or gas therefrom can collect in such a quantity as to become dangerous; and no such receptacle or receptacles shall be stored, kept or handled at any time within fifteen feet of any gas, candle, oil or other like artificial light or near any lighted stove, gas grate or any open flame of any kind whatsoever; provided, however, that a quantity of such oils exceeding one barrel of fifty gallons and not exceeding five barrels of fifty gallons each may be kept or stored in a room or apartment, the floor of which shall be at least five feet below the grade of the street adjacent to the building or structure in which such room or apartment is located, and such room or apartment shall have an air capacity of not less than fifteen hundred cubic feet and shall be properly ventilated in such manner as to prevent a dangerous accumulation of vapor or gas from such oils; and such room or apartment shall not be used for any purpose other than the storage and handling of such oils. In any such room or apartment as is last above described turpentine may be kept in a quantity not exceeding five hundred gallons.

No gas, candle, oil, or other like artificial light or lighted stove, gas grate, or other open flame of any kind whatsoever shall be allowed within fifteen feet of any receptacle or receptacles containing any of the oils or fluids mentioned in this article, while located, kept, or stored in any such room or apartment. If more than fifteen (15) barrels of any of the oils hereinbefore described are kept in any such building as herein provided for, such building shall be located not less than 100 feet away from any other building or structure.

Sec. 720. (Petroleum, Etc., in Transit Not to Be Kept Near Buildings.)—It shall be unlawful for any person or corporation engaged in the business of transporting or delivering any of the oils or fluids mentioned in this article to permit such oils or fluids to remain in barrels, tanks, or other like receptacles, upon any railroad track, street, wharf, or dock for a longer time than is reasonably necessary to make provision for the storing or delivering of same; such time in no event, however, to exceed twenty-four hours.

Sec. 721. (Oils, Sale of, Regulated.)—It shall be unlawful for any person or corporation to sell, deliver, or receive any of the oils or fluids mentioned in this article, by gas, candle, oil, or other like artificial light.

ARTICLE XXV.

MISCELLANEOUS PROVISIONS.

Sec. 722. (Roofs for Spectatorial Purposes.—Permits.)—It shall be unlawful for any person, whether owner, lessee, manager or person in control or having charge of any building within the city, to permit the use of the roof of any house or building, whether free of charge or through admission fee, to any person as a place of observation or for spectatorial purposes, unless he has first obtained from the Commissioner of Buildings of the city a permit; provided, however, it shall not be unlawful for any person, whether, owner, lessee, or the person in control or having charge of such house or building, to permit the roof of any such house or building to be used as a place of observation or for spectatorial purposes for a number of persons not exceeding ten, and when no admission fee is charged.

Sec. 723. (Inspection as to Safety of Buildings.)—Before issuing the permit, as provided for in the foregoing section, the Commissioner of Buildings shall make an investigation as to whether such building is safe and secure enough to permit the presence of an estimated number of persons upon the roof thereof, and the permit so issued shall state the number of persons to be permitted on such roof. The Commissioner of Buildings shall see to it that every such roof is surrounded and enclosed with a railing or balustrade of sufficient height and strength to afford adequate protection.

Sec. 724. (Fee for inspection.)—The person requiring such permit, as hereinabove provided for, shall make application to the Commissioner of Buildings for such an investigation, and shall pay, as a fee for such investigation and such permit, the sum of five dollars.

Sec. 725. (Penalty.)—Any person, whether owner, lessee, manager or person having charge or control of any such house or building within the city who shall permit, allow or tolerate the use of the roof of such house or building so controlled by him, by any person for a purpose within the meaning of Section 722 of this article, without first obtaining a permit as hereinbefore provided for, and without having the safety of such roof tested and investigated by the Commissioner of Buildings, as hereinbefore provided for, or who shall permit a larger number of persons than is provided for in his permit to congregate upon such roof, shall be fined not less than twenty-five dollars nor more than one hundred dollars for each offense.

Sec. 726. (Windows, Cleaning of.—Safety Devices.)—The owner or agent of every building hereafter erected in the city shall equip each and every window in any such building, above the second story thereof, with a suitable device or devices which will permit the cleaning of the exterior of each and every window in such building, above the second story, without danger to the person cleaning such windows, such devices shall be of such pattern and construction as will reasonably answer the purposes for which they are intended. Provided, however, that if windows are of such size that they may be easily cleaned from the inside, they need not be equipped with such devices.

Sec. 727. (Penalty.)—Any owner or agent of any building described in the preceding section who shall fail, neglect or refuse to comply with any of the provisions of such section, shall be fined not less than ten dollars nor more than fifty dollars for each offense, and each and every day which shall be allowed to elapse before any such building shall be supplied and equipped in accordance with the provisions of said section, shall constitute on the part of the owner or agent of any such building a separate and distinct offense.

Sec. 728. (Scaffolds.—Protection During Building Operations.—Temporary Floors.)—All scaffolds erected in this city for use in the erection, repair, alteration or removal of buildings, shall be well and safely supported, and of sufficient width, and properly secured, so as to insure the safety of persons working thereon or passing under, or by the same, and to prevent the falling thereof, or of any material that may be used, placed or deposited thereon.

It shall be the duty of every owner, person or corporation who shall have the supervision or control of the construction or remodeling of any building having more than three (3) framed floors, whether some or all of such floors are above or below the established street grade, to provide and lay upon the upper side of the joists or girders, or both, of the first floor below the riveters and structural steel setters, a plank floor, which shall be laid to form a good and substantial temporary floor for the protection of employes and all persons engaged above or below or on such temporary floor in such building.

Provided, however, that where the permanent floor is in place on the floor herein required to be planked, a temporary protective floor shall not be required.

If the floor or permanent floor of the second floor, or of any other floor above the second, or roof, is being placed previous to the permanent floor of the floor immediately below the floor which is being arched or planked, a good and substantial temporary floor shall be laid on the joists and girders of the next lower floor. For the purposes of this section the lowest framed floor in a building shall be considered the first floor.

In buildings more than three (3) stories high, where persons are working on a scaffold or scaffolds on the outside of such building, such persons shall be protected by well-secured planking, set over the heads of such persons for the full width of the scaffolding on which they are working, if another story or other stories are being raised above such persons during the time they are working on such outside scaffold or scaffolding.

It shall be the duty of all owners, contractors, builders or persons having the control or supervision of all buildings in course of erection which shall be more than thirty (30) feet high, to see that all stairways, elevator openings, flues and all other openings in the floors shall be covered or properly protected.

Sec. 729. (**Penalty.**)—Any person violating any of the provisions of the foregoing section shall be fined not less than one hundred dollars nor more than two hundred dollars for each offense, and any permit granted for the construction of such building by the authorities of the city may be revoked in the discretion of the Commissioner of Buildings.

Sec. 730. (**Gas or Electric Shut-off Device.—Outside of Building.**)—Every building within the city in which gas or electricity is used for illuminating, heating or other purposes shall be equipped with a device or devices which will enable firemen to shut off the supply of gas or current of electricity to any such building from the outside thereof; such device or devices to be placed at such a point or at such points on the outside of any such building as may be designated by the Fire Marshal of the city, and to be of such design and construction as to enable such device or devices to perform with reasonable certainty and safety the work required to be done thereby.

Any device or devices installed for the purpose of carrying out the provisions of this section shall first be approved by the Fire Marshal, and after the installation thereof the control of any such device or devices so installed in or upon any building under the provisions of this section shall be under the supervision of the Fire Department of the city.

Provided, however, that buildings used exclusively for residence purposes and outbuildings, sheds or barns attached or appurtenant to buildings used exclusively for residence purposes, shall be exempted from the provisions of this section.

Sec. 731. (**Penalty.**)—Any owner, agent or person having control or charge of any building coming within the provisions of the foregoing section, who shall neglect, fail or refuse to equip any such building with a device or devices such as are described in the foregoing section, shall be fined not less than fifty dollars nor more than two hundred dollars for each offense, and each day which shall elapse before the equipment of any such building with a device or devices as herein required shall be deemed a separate and distinct offense, and any person who shall disturb, meddle or tamper with any device or devices installed under the provisions of the preceding section, upon any building or buildings, without authority from the Fire Marshal, shall be fined not less than ten dollars nor more than one hundred dollars for each offense.

Sec. 732. (**License.—Contractors.**)—Every person or corporation engaged within the city in the construction or repairing of the whole or any part of buildings and appurtenances shall be and he or it is hereby required to obtain a license from the city which shall permit him or it to engage thereafter in the business of contracting for the erection of buildings and appurtenances or parts thereof.

Sec. 733. (**Application.—Conditions.**)—Every application for such license shall be made to the Commissioner of Buildings and shall set forth the name and residence or place of business of the applicant and the nature of the work which he or it desires to engage in for a period of one year thereafter, and shall be accompanied by a fee of two dollars.

Sec. 734. (**License to Be Issued.**)—Said Commissioner shall thereupon issue a license in due form, permitting the applicant to engage in the business of contracting for the erection of buildings and appurtenances, or parts thereof, in the city for one year from the date of such license, which date shall be the first day of May in the year in which such license is applied for, and no license shall be granted for any period less than a year, and all licenses shall run from the first day of May in each year until the thirtieth day of April in the succeeding year.

Sec. 735. (**Penalty.**)—Any person or corporation who shall engage in the business of building in the city under contracts for the whole or any part of buildings and appurtenances, without first having obtained a license therefor as aforesaid, shall be fined not less than twenty-five nor more than one hundred dollars for each offense.

Sec. 736. (**Walls.—Structures.—Buildings Altered to Conform to Chapter.**)—No wall, structure, building or part thereof shall hereafter be built, constructed, altered or repaired within the city except in conformity with the provisions of this chapter. No building already erected or hereafter to be built within the city shall

be raised, altered or built upon in such a manner that if such building were wholly rebuilt or constructed after the passage of this ordinance it would be in violation of any of the provisions of this chapter.

Sec. 737. (Buildings.—Expense of Altering Recoverable from Owner by City.)—Whenever, in the opinion of the Commissioner of Buildings, it shall be necessary to tear down, alter, repair or rebuild any building or portion of any building which is dangerous, defective or unsafe, or which is reported to the said Commissioner by the Commissioner of Health to be unfit for human occupancy, or which has been built in violation of any of the provisions of this chapter or of any ordinance regulating the construction of buildings hereafter passed, said Commissioner of Buildings shall cause such building or such portion thereof to be torn down, altered, repaired or rebuilt, or such work to be done thereon as he may deem necessary to render such building, or such portion thereof, safe or fit for human occupancy, and the expense thereof shall be recoverable from the owner or owners of such building by any proceeding that may be deemed appropriate.

Sec. 738. (Penalty.—Fines for Violation of Chapter.)—Any person or corporation who violates, neglects or refuses to comply with, or who resists or opposes the enforcement of any of the provisions of this chapter, shall be fined not less than twenty-five nor more than two hundred dollars for each offense, and every such person or corporation shall be deemed guilty of a separate offense for every day on which such violation, neglect or refusal shall continue; and any builder or contractor who shall construct any building in violation of any of the provisions of this chapter, and any architect designing or having charge of such building who shall permit it to be constructed, shall be liable to the penalties provided and imposed by this section.

AMENDMENTS

Sections 471 and 680 of the revised municipal code were amended July 8, 1907.

Be it ordained by the City Council of the City of Chicago:

Section 1. That Sections 471 and 680 of the Revised Municipal Code of Chicago of 1905, as amended by the ordinance of March 19th, 1906, be and the same are hereby amended so that they and each of them shall read as follows:

471. Standpipes—Pumps—Axes, Etc.—(1). In every building over one hundred (100) feet in height not provided with a three (3) inch or larger inside standpipe, in all buildings hereafter constructed of a greater height than seventy-five (75) feet (except buildings used for theatre purposes, as herein elsewhere provided for); in all buildings used for hospital purposes of a greater height than three (3) stories with accommodations for at least twenty (20) patients; and in all buildings of a greater height than five (5) stories now or hereafter used for hotel or public lodging house purposes there shall be constructed one (1) or more four (4) inch standpipes which shall extend from basement to roof and which shall be connected at street or alley side of building with two-way Siamese connection for use of fire department, and which shall be provided with one hose connection, with fire department thread, on the roof of said building, on each floor and in the basement thereof, with sufficient hose attached to reach any point thereof. The pattern, quality, installation, and maintenance of such standpipe, hose and couplings, shall be subject to the approval of the Fire Marshal.

(2) In any of the buildings herein referred to where approved sprinkler systems are installed and properly maintained, it shall not be necessary to install additional inside standpipe as above provided for.

(3) On each floor and in the basement of every building used for hotel, public lodging, or school purposes, three or more stories in height, there shall be two (2) or more portable hand pumps or chemical extinguishers, one or more fire axes and one or more pike poles. In the basement or janitor quarters of all apartment buildings three or more stories in height, the floors of which are divided into two or more apartments, and in the basement of all office buildings four or more stories in height there shall be provided one or more portable hand pumps or chemical extinguishers, one or more fire axes and one or more pike poles; all of which shall be installed and maintained subject to the approval and supervision of the Fire Marshal.

(4) The interior of all grain elevators and malt houses of a height of fifty (50) or more feet, which are not entirely fire-proof, and which have a capacity of two hundred and fifty thousand (250,000) bushels or over, and the interior of all cold storage houses of a height of four (4) or more stories, which are not entirely fire-proof and which have a ground floor area of ten thousand (10,000) or more square feet, shall be equipped with either a dry or wet sprinkler system, to each of which systems there shall be a

feeder or riser pipe or pipes not less than four (4) inches in diameter, leading from one or more Siamese steamer connections; all of which shall be installed and maintained subject to the approval of the Fire Marshal.

(5) Grain elevators which are equipped with Journal Fire Alarm Systems of the most approved pattern and which are left at all times in the most perfect working order, or grain elevators, malt houses and cold storage houses, which are now equipped with standpipes of approved pattern and hose with not less than two (2) inch connections which have been installed in accordance with city ordinances and approved by the fire department, each floor of which is approved by said department as being at all times easily accessible to firemen, where fire extinguishers, water barrels and pails are distributed at intervals on all floors on advice and instruction of the Chicago Underwriters' Association; where the necessary pump pressure is maintained; where some approved electric watch service and fire alarm system is maintained and watchmen are employed during nights, Sundays and holidays, pulling such stations not less frequently than once per hour, and which have outside Siamese connections and standpipes not less than two and one-half (2½) inches, shall be exempt from the provisions of this ordinance.

Sec. 2. This ordinance shall be in force and effect from and after its passage.

STEAM BOILER AND STEAM PLANT INSPECTION DEPARTMENT.

This ordinance was passed by the City Council on July 8, 1907, but up to time of going to press, had not been signed by the Mayor.

According to the Municipal Code, with code number and amendments to date.

Section 2204—Department Established—Chief Inspector: There is hereby established a department for the inspection of steam boilers and steam plants, the head of which shall be known as the Chief Inspector of Steam Boilers and Steam Plants.

Sec. 2205—Appointment: He shall be appointed by the Mayor by and with the advice and consent of the City Council.

Sec. 2206—Qualification: The person so appointed shall be well qualified from practical experience in the design or construction and operation of boilers, generators, and superheaters, and their appurtenances, used for generating steam for power, steaming or heating purposes, to enable him to judge of their safety for use as such. No person employed in the department created by this chapter shall be directly or indirectly interested in the manufacture, ownership, or agency of steam boilers or other apparatus or appliances used in the generation or use of steam, which are to be inspected.

Sec. 2207—Bond: The Chief Inspector of Steam Boilers and Steam Plants, before entering upon the duties of his office, shall execute a bond to the City of Chicago in the sum of five thousand dollars (\$5,000) with sureties to be approved by the Mayor, conditioned for the faithful performance of the duties of his office.

Sec. 2208—Supervising Mechanical Engineer: There is hereby created the office of Supervising Mechanical Engineer and Chief Deputy Inspector of Steam Boilers and Steam Plants. He shall be appointed by the Chief Inspector of Steam Boilers and Steam Plants according to law.

Sec. 2209—Bond: The Supervising Mechanical Engineer and Chief Deputy Inspector of Steam Boilers and Steam Plants, before entering upon the duties of his office, shall execute a bond to the City of Chicago in the sum of five thousand dollars (\$5,000), with sureties to be approved by the Comptroller, conditioned for the faithful performance of the duties of his office.

Sec. 2210—(Repealed July 8, 1907)—See Smoke Ordinance.

Sec. 2211—(Amended July 8, 1907)—Board of Inspectors of Steam Boilers and Steam Plants—to inspect City and Board of Education Boilers: The department of steam boilers and steam plants shall have the same power over all steam boilers and steam plants owned or operated by the city or Board of Education as over all other steam boilers and steam plants in said city; and all steam boilers or steam plants owned, operated or controlled by the city or the board of education of said city shall be subject to the requirements of this chapter; and it shall be the duty of said department to inspect at least once in each year all of such steam boilers and steam plants as are owned, operated or controlled by the city or said Board

of Education, and also to preserve a record of the condition of such steam boilers or steam plants as shown by such inspection. No fee shall be charged or paid to said department nor to any employe under said department for the inspection of any steam boiler or steam plant or for the certificate of inspection issued by said department for any steam boiler or steam plant owned, operated or controlled by said city.

Sec. 2212—(Amended July 8, 1907)—**Duties of the Board:** It shall be the duty of the department to inspect all boilers, tanks, jacket kettles, generators or other apparatus used for generating or transmitting steam for power, or using steam under pressure for heating or steaming purposes, and all other tanks, jacket kettles, and reservoirs under pressure of whatsoever kind, except as hereinafter provided, as often as once in each and every year, by making a hydrostatic pressure test where such tests shall be deemed necessary; Provided, that the hydrostatic pressure used in such test shall not exceed the maximum working pressure of said apparatus by more than fifty per cent; and by making a careful external and internal examination. In all cases where hydrostatic pressure test is used an internal examination of said apparatus shall afterwards be made. In certifying the working pressure allowed on each steam generator or other apparatus the same shall be determined by multiplying one-fifth of the lowest tensile strength of any plate in the cylindrical shell of said steam boiler or steam generator or other apparatus by the lowest efficiency of joint in such cylindrical shell expressed in decimals, and by multiplying the product by the thickness, expressed in inches or parts of an inch, of the thinnest plate in the same cylindrical shell and divide by the radius, also expressed in inches. This sum will be the pressure allowable per square inch of surface.

Any boiler, tank, jacket kettle, generator or reservoir having been in use eight years or more and its condition being such that in the opinion of the inspector the same should be drilled in order that the exact thickness and condition may be ascertained, he shall report the same to the Chief Inspector of Steam Boilers, who shall serve the owner or agent with a written notice to show cause to the Chief Inspector within five days why such boiler, tank, jacket kettle, generator or reservoir should not be drilled.

If, after the owner or agent has been heard, or at the end of five days, the Chief Inspector deems it necessary that the boiler, tank, jacket kettle, generator or reservoir be drilled, then the boiler, tank, jacket kettle, generator or reservoir may be drilled at points near the water line, and at the bottom of shell of boiler, or such other points in the boiler, tank, jacket kettle, generator or reservoir as the inspecting officer may direct, and the thickness of said material shall be determined thereafter at such annual inspection as the inspecting officer may deem necessary, and the steam pressure or other pressure allowed shall be governed by such ascertained thickness and general condition of boiler, tank, jacket kettle, generator or reservoir. And the drilling and plugging of said holes shall be done at the expense of the owner.

Any boiler may be tested and rated in accordance with the United States Marine Inspection Law governing the inspection of steam boilers. But no boiler, tank, jacket kettle or jacket constructed or reconstructed of boiler plates hereafter, where the same are required shall have stay bolts of less than seven-eighths of an inch in diameter and pitched more than seven inches apart. All stationary boilers, tanks, jacket kettles or jackets carrying a pressure of one hundred pounds or over to the square inch, the construction of which requires stay bolts, shall be equipped with hollow stay bolts. All boiler heads made of boiler plate shall be braced with braces, the sectional area of which shall not be less than one square inch each, so pitched that a greater strain than six thousand pounds per square inch of section shall not be carried by any one brace or stay bolt. In computing the strain on braces in flat surfaces the diameter of brace rivets shall be considered. In computing the strain on shells having dished heads the pressure will be figured according to the radius of the heads.

It shall be the duty of the department to see that the boiler or boilers, boiler setting, means of producing draft, smoke connections and furnace or fire box of each boiler inspected by it are of sufficient capacity or so constructed as with proper management to avoid the issuance or emission of dense smoke from any chimney or smokestack connected therewith.

Sec. 2213—(Repealed July 8, 1907): See Smoke Ordinance.

Sec. 2214—Repealed by City Council January 22, 1906.

Sec. 2215—(As amended January 2, 1906)—**Prosecutions for Violations—by Whom to be Instituted:** Provides that prosecutions for all violations of above section shall be instituted by the Chief Inspector of Steam Boilers and Steam Plants or his deputy in the name of the City of Chicago.

Sec. 2216—(Amended July 8, 1907)—Permit for New Plants, Plans, Etc.: No new plants, nor any reconstruction of any old plants, for producing power and heat, or either of them shall be erected or maintained in the city until the plans and specifications of the same have been filed in the office of and approved and a permit for such erection or construction issued by the Chief Inspector of Steam Boilers and Steam plants, which plans and specifications shall show the amount of work and the amount of heating to be done by such plant and all the appurtenances thereto, including provisions for the complete combustion of the fuel to be used and a statement of the kind of fuel proposed to be used. Such plans and specifications shall also show that the room or apartment in which such plant shall be located is provided with doors, windows, air-shafts, fans, and other means of ventilation sufficient to prevent the temperature of such room, apartment, basement or other portion of such building wherein such steam plant or apparatus is to be used, from rising to a point higher than one hundred and twenty degrees Fahrenheit, or that the atmosphere of any such apartment wherein such apparatus may be located may be entirely renewed every ten minutes. Upon approval of such plans and specifications, a duplicate set of which shall be left on file in said office, and the payment of fees as hereinafter provided, and upon the presentation to the department of a permit issued by the department of smoke inspection, said Chief Inspector shall issue a permit for the installation of such plant or such reconstruction. Such permit shall state the maximum amount of steam pressure to be carried. As soon as the department hereby created has examined the plans and specifications submitted for a new steam plant in a new building and has issued a permit for the installation of same it shall notify the Commissioner of Buildings to see that the execution of the construction work on the building in which such plant is to be installed is carried out in conformity with the plans and specifications of the proposed steam plant for the execution of which a permit has been issued, with special reference to the amount of space to be used for such appurtenances, the size and construction of the chimney or chimneys to be used, and the provisions for ventilation and proper temperature in the engine and boiler room.

It shall be the duty of the Supervising Mechanical Engineer and Chief Deputy Inspector of Steam Boilers and Steam Plants to examine in detail all plans and specifications that may be submitted to the department, and to report upon the same for approval by the department.

Sec. 2217—(Amended July 8, 1907)—Duty of Owners: It shall be unlawful for any person to use any steam boiler or any tank or tanks subject to pressure other than city pressure, until he shall have first procured a certificate from said Chief Inspector that such apparatus may be safely used, and that the boiler or boilers boiler setting, means of producing draft, smoke connections and furnace or fire box are of such size and capacity that they will do the work required, and be capable of being so managed for the purpose of generating steam that no dense smoke shall be emitted from the chimney connected with such furnace or fire box.

If such owner, agent or person using a steam boiler or tank shall fail to notify said Chief Inspector of his intention to make any alteration, repairs or enlargement of such steam plant, and shall fail to file plans and specifications for the enlargement or alterations of the same, and shall proceed to make such alteration, repairs or enlargement without a permit therefor, he shall be liable to a fine of twenty-five dollars for each day on which he shall have prosecuted such alteration, repairs or enlargement without said permit, and each day's violation shall constitute a separate offense. Provided, however, that minor necessary or emergency repairs which do not increase the capacity of such apparatus or involve any substantial alteration of structure may be made by or under the engineer in charge of such apparatus without permit or report thereof.

If at any time when inspecting a steam boiler, generator or other apparatus used for generating steam for power or heating purposes the inspector of boilers shall find that the furnace or fire box in which fuel is used for the purpose of generating steam is so constructed or operated as to cause the emission of dense smoke from the chimney connected therewith he shall report to the department of smoke inspection the condition of such plant.

Provided, that any boilers for heating purposes only, in which the permit specifies that not more than ten pounds of steam pressure to the square inch shall be carried, shall be known as "low pressure boilers."

After the next inspection of such low pressure boilers shall have been made following the adoption of this ordinance, inspections thereafter shall be made once in every three years. But all of such low pressure plants may be inspected at any time thereafter and without charge, with reference to the provisions for draft, complete combustion or degree of combustion of fuel and prevention of the emission of smoke.

Sec. 2218—Exceptions: The provisions of this chapter relating to the inspection of boilers, generators or other apparatus carrying other than city pressure shall not apply to such boilers, generators or apparatus while in use or installed in any locomotive, steam or tug boat. The provisions of this chapter relating to the inspection of steam boilers, generators or other apparatus carrying other than city pressure shall be held to apply to any such steam boiler, generator or apparatus in use or installed in any steam roller, steam derrick, steam pile driver, automobile or other movable structure or contrivance of any kind whatsoever used within the city. Provided, however, that this ordinance shall not apply to boilers, generators or other apparatus used in private residences for generating steam solely for heating purposes; and for the purpose of this ordinance flat buildings or apartment buildings with more than three apartments shall not be classed as private residences, and any steam boiler, generator or other apparatus used for generating steam in flat buildings or apartment buildings having more than three flats or apartments shall be subject to inspection as hereinbefore provided.

Sec. 2219.—Certificate—Record: When an inspection of a boiler or boilers, tank or tanks, jacket-kettle, generator or generators, superheater or superheaters, or any apparatus under pressure, has been made, and the same shall be approved by the Chief Inspector or Supervising Mechanical Engineer and Chief Deputy Inspector of Steam Boilers and Steam Plants, he shall make and deliver to the person for whom the inspection was made, upon the payment of the fees hereinafter mentioned, a certificate of such inspection, which shall contain the date of inspection, together with a general description, for what purpose used, the number of try-cocks, steam and water gauges, the pounds pressure at which they may be safely used; which certificate shall be framed and put up in a conspicuous place in the engine or boiler room, and a record of the same shall be made and kept by said Board, in a well-bound book or books, indexed alphabetically or by locality.

Sec. 2220—See Smoke Ordinance.

Sec. 2221—Inspection of Repairs: It shall be the duty of said Inspector, upon an application in writing made by any person, firm, corporation, or agent, owning, leasing or controlling the use of any boiler, tank, jacket-kettle, generator, or superheater, stating that the same is out of repair or has been repaired, to examine the same when so repaired, and determine if such repairing has been properly done; and it shall be unlawful for any person, firm, corporation, or agent to use any boiler, tank, jacket-kettle, generator, or superheater, after the same has been repaired, until a certificate shall have been procured from the Inspector to the effect that such repairing has been properly done, and such boiler, tank, jacket-kettle, generator, or superheater may be safely used, except as hereinbefore provided in this chapter.

Sec. 2222—Fees: The fees for inspection of steam boilers and other apparatus under this chapter shall be as follows:

Class A. Including steam boilers, tanks, jacket-kettles, of a capacity of seventy-five gallons or over, generators, or other apparatus under a pressure exceeding ten pounds per square inch in plants where only one such apparatus is used, five dollars each.

Class B. Steam boilers, generators, or superheaters under pressure exceeding ten pounds per square inch in plants where more than one such is used, five dollars for the first and three dollars for each additional apparatus.

Class C. Tanks and jacket-kettles, of a capacity of seventy-five gallons or over, under pressure in plants where more than one such tank or jacket-kettle is used, one dollar each for all after the first.

Class D. All low-pressure steam boilers as herein described in this chapter, three dollars each.

Class E. The fee for a permit for a new steam plant or for additions to an old plant shall be five dollars for each boiler or tank to be used under pressure or for the addition or rebuilding of any smokestack or chimney or for any material alteration or change made in such plant. The fee for the inspection of steam boilers and other apparatus above provided for shall be double the respective amounts above specified when an inspection is made on Sunday or any legal holiday at the request of the person or corporation owning or operating said steam boilers or other apparatus.

All fees provided for in this chapter shall be paid to the City Collector.

Sec. 2223—(Amended July 8, 1907)—Exemptions—Charitable, Religious and Educational Institutions: Said Chief Inspector may, and he is hereby directed and instructed to remit all inspection fees charged, or that may hereafter be charged, against any and all charitable, religious, and educational institutions, when the boiler

or other apparatus inspected is located in or upon premises used or occupied exclusively by such charitable, religious or educational institution; Provided, that such charitable, religious or educational institution is not conducted or carried on for private gain or profit, and provided further, that said Chief Inspector may require every application for the remission of such fees to be verified by the affidavit of one or more taxpayers of the city.

Sec. 2224—Charging Excess Fees: If any person acting on behalf of the city under the provisions of this charter shall take or receive any money or any valuable thing for the purpose of deceiving or defrauding any person or persons, or for the purpose of favoring any person or persons, or if any inspector shall recommend the issue of any certificate of inspection without having at the time stated thoroughly examined and tested the boiler so certified, he shall be fined one hundred dollars (\$100) for each offense.

Sec. 2225—(Amended July 8, 1907)—Try-cocks, Gauges, Force Pumps: It shall be the duty of every person or corporation owning, leasing or controlling the use of any steam boiler or boilers, subject to inspection, as hereinbefore provided, to provide and properly affix to each and every one of such boilers a full complement of try-cocks, one water gauge, one fusible plug of good Banca tin, one or more pop safety valves (the area of pop valves shall be in the ratio of one square inch to three square feet of grate surface): Provided, that on boilers used for generating steam for heating purposes only and carrying not more than ten pounds steam pressure, direct weighted safety valves may be used. On each steam boiler or steam generator, or other apparatus subject to inspection, there shall be placed a suitable shut-off or main stop valve so placed as to prevent the water passing into the heating apparatus during the test made at the time of inspection; Provided, that shut-off or main stop valves shall be required only in plants to be hereafter installed, and a good and sufficient force pump or other means of supplying the boiler with water; also a good and sufficient safety valve or reducing valve to all tanks or jacket kettles, properly attached. No stop or shut-off valve shall be placed between a boiler, tank or jacket kettle and the safety valve.

After inspection the inspector shall seal all safety valves, and said seal shall not be broken, except by authority of said department, except in case of emergency and when the seal is broken a complete report of the same shall be made to said department within twenty-four hours; and said valve shall be resealed forthwith by said department without charge, provided the circumstances of the breaking of said seal are approved by said department.

Sec. 2226—Owners to Provide Facilities: Every person owning or having possession or control of any steam boilers, tanks, jacket-kettles, generators, or superheaters, subject to inspection as aforesaid, shall provide at his own expense proper arrangements and facilities for attaching the instruments of inspection. Immediately before the time set for such inspection, every person shall remove all scale, dirt, soot, and sediment in, beneath, and around such boiler, shall fill the same with water, when so directed by the Inspector, and have all main stop valves and other valves and connections on said boiler or boilers perfectly tight, so that the Inspector may be able to apply hydrostatic pressure, leaving all said apparatus in clean condition for inspection.

Sec. 2227—Engineer's Negligence, Maximum Pressure, and Safety Valves: Any engineer or other person in charge of a steam boiler or generator who shall negligently or wrongfully endanger the life of any person by permitting the water to fall below three inches above the flues or crown sheet of any boiler, or shall disturb the spring or weight on the safety valve, or break the seal of the safety valve, or tamper with it so as to carry more pressure than allowed by the Inspector, or who shall otherwise neglect his duties, shall be subject to a fine of not less than \$25 nor more than \$100 for each offense and it shall be the duty of the Chief Inspector to report the facts to the Board of Examining Engineers.

The safety valves of steam boilers shall not be loaded to sustain more than the maximum pressure allowed by said Inspector, and the area of the discharge of each safety valve shall be equal to the full area of the valve, and all safety valves shall be directly open to the atmosphere.

Sec. 2228—(Amended July 8, 1907)—Manufacturers and Dealers—Notify Inspectors: Any person or corporation manufacturing, dealing in, selling or erecting steam boilers, tanks, jacket kettles, or generators, subject to inspection under this chapter, shall, on the sale or delivery of such steam boiler, tank, jacket kettle, or generator at any point or locality within the city, notify the said Chief Inspector, giving the name of the owner, name of maker, number and name of street, or otherwise designate the locality of said delivery or sale; shall state also the thickness and quality of the material used in the construction and the brand stamped on the plate.

Sec. 2229—Second-Hand Dealers: All steam boiler manufacturers, second-hand steam boiler and junk dealers, and any other person selling second-hand steam boilers, tanks, jacket-kettles, generators, or superheaters, shall before painting the same have them inspected by the Department of Steam Boiler and Steam Plants, and have in their possession a certificate issued by said Department, showing the amount of pressure per square inch the said steam boiler, tank, jacket-kettle, generator or superheater is allowed to carry before offering for sale any second-hand steam boiler, tank, or jacket-kettle, generator, or superheater, and give the buyer the said certificate of inspection. Any person or corporation violating this section shall be fined not less than ten dollars (\$10), nor more than one hundred dollars (\$100), for each offense.

Provided that any person or persons disposing of a second-hand steam boiler, tank, jacket-kettle, generator, or superheater, which has been in use, shall not be required to secure inspection if said steam boiler, tank, jacket-kettle, generator, or superheater is sold to a dealer in or repairer of such apparatus, but such inspection shall be had before such articles are sold for use.

Sec. 2230—Penalty: Any person who shall violate any of the provisions of this chapter shall be fined not less than twenty-five dollars (\$25), nor more than one hundred dollars (\$100), for each offense.

Sec. 2231—(Amended July 8, 1907)—Apparatus—Record: The city shall provide such instruments, books, papers, and equipment as shall be necessary for the proper performance of the duties of such department, which shall be the property of said city, and which shall be delivered by said Chief Inspector to his successor in office. Said Chief Inspector shall report annually on or before the first day of February to the Mayor and City Council, and as often as required by said Council.

Said department shall prepare and keep in its office a record of each steam boiler, steam generator, tank, jacket-kettle, or other apparatus used for the generation of steam or under pressure other than city pressure, and at the first inspection of any such apparatus under and by virtue of this chapter a number shall be securely stamped upon the same with a steel stamp or die, of not less than one-half inch in height, in a conspicuous and easily accessible place upon said apparatus, which number shall be the office number of such piece of apparatus, and the designation by which the same shall be known in said record after such inspection; and said record shall contain a full description of such piece of apparatus, together with the use for which it is employed, the place where it may be located, the name of the owner, agent, or lessee of said apparatus, together with the amount of pressure allowed by the Inspector for the same, and the kind of fuel used, together with the number of try-cocks, steam and water gauges, and any special information pertaining thereto, including a record of inspections made.

Sec. 2232—(Amended July 8, 1907)—Report Defects in Furnaces and Smokestacks: It shall be the duty of the assistant inspectors to report to said Chief Inspector defects in furnaces and smoke-stacks as well as in boilers.



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SMOKE INSPECTION DEPARTMENT

This ordinance was passed by the City Council on July 8, 1907, but up to time of going to press had not been signed by the Mayor.

Providing for smoke inspection and abatement in the City of Chicago.

Section 1. There is hereby established a department of smoke inspection, the head of which shall be known as the Smoke Inspector.

Sec. 2. The Smoke Inspector shall be appointed by the Mayor by and with the advice of the City Council.

Sec. 3. The person so appointed shall be a mechanical engineer, qualified by technical training and experience in the theory and practice of the construction and operation of steam boilers and furnaces and also in the theory and practice of smoke abatement and prevention.

Sec. 4. The Smoke Inspector, before entering upon the duties of his office, shall execute a bond to the City of Chicago in the sum of ten thousand dollars, with sureties to be approved by the Mayor, conditioned upon the faithful performance of the duties of his office.

Sec. 5. The salary of the Smoke Inspector shall be four thousand (\$4,000) dollars per annum.

Sec. 6. There is hereby created the office of chief assistant smoke inspector, who shall be appointed by the Smoke Inspector as provided by law.

Sec. 7. The qualifications of the chief assistant smoke inspector shall be the same as the qualifications herein provided for the Smoke Inspector.

Sec. 8. The chief assistant smoke inspector shall, before entering upon the duties of his office, execute a bond to the City of Chicago in the sum of five thousand dollars (\$5,000), with sureties to be approved by the Mayor, conditioned upon the faithful performance of the duties of his office.

Sec. 9. The salary of the chief assistant smoke inspector shall be three thousand (\$3,000) dollars per annum.

Sec. 10. There shall be as many deputy smoke inspectors as shall be provided for by the City Council; their compensation shall be fixed by the City Council and they shall be appointed by the Smoke Inspector in the manner provided by law.

Sec. 11. There shall be as many assistant smoke inspectors as shall be provided by the City Council; their compensation shall be fixed by the City Council and they shall be appointed by the Smoke Inspector in the manner provided by law.

Sec. 12. There shall be as many clerks and stenographers assigned to this department as shall be provided by the City Council; their compensation shall be fixed by the City Council and they shall be appointed by the Smoke Inspector in the manner provided by law.

Sec. 13. The Mayor may in his discretion appoint a Smoke Abatement Commission composed of eight members who shall act as advisors to the Mayor in the organization of the department and as advisors to the Smoke Inspector in the conduct of the department. The Smoke Inspector shall at all times receive, place and keep on file in his office any suggestion, recommendation, advice or other communication which may be presented to him in writing by the Smoke Abatement Commission. The Smoke Abatement Commission may name an advisory board of mechanical engineers which shall consist of three consulting engineers of recognized ability and integrity who have had experience in the installation and conduct of power and heating plants. This board shall act as advisors on engineering questions to the Smoke Abatement Commission and to the Smoke Inspector and to the members of the department. Meetings of the advisory board of mechanical engineers may be called at any time either by the Smoke Abatement Commission or by the Smoke Inspector. Members of the advisory board of mechanical engineers shall receive as their compensation the sum of ten dollars (\$10) for each member for each regularly called meeting attended.

Sec. 14. No new plants or any reconstruction of any old plants for producing power and heat, or either of them, or any new chimney connected with a steam plant shall be erected or maintained in the city until plans and specifications of the same have been filed in the office of and approved by the Smoke Inspector and a permit issued by him for such erection, reconstruction or maintenance. Plans and specifications to be filed with the Smoke Inspector shall show the amount of work and the amount of heating to be done by such plant and all appurtenances thereto, including all provisions made for the purpose of securing complete combustion of the fuel to be used and for the purpose of preventing smoke; said plans and specifications shall also contain a statement of the kind of fuel proposed to be used, and said plans and specifications shall also show that the room or apartment in which such plant shall be located is provided with doors, windows, air-shafts, fans and other means of ventilation sufficient to prevent the temperature of such room, apartment, basement or other portion of such building wherein such steam plant or apparatus is to be used, from rising to a point higher than 120 degrees Fahrenheit, and sufficient also to provide that the atmosphere of any such apartment, wherein such apparatus may be located, may be entirely renewed every ten minutes. Upon the approval of such plans and specifications, a duplicate set of which shall be left on file in said office, and upon the payment of the fees as hereinafter provided, the Smoke Inspector shall issue a permit for the reconstruction, erection or maintenance of such plant. As soon as the Smoke Inspector has examined the plans and specifications submitted and has issued a permit as above provided, he shall notify the Commissioner of Buildings to see that the execution of the work permitted is carried out in conformity with the plans and specifications, with special reference to the amount of space used, the size and construction of the chimney or chimneys used, the provisions for the prevention of smoke, and the provisions for ventilation, and for the proper temperature in the engine and boiler rooms.

Sec. 15. It shall be unlawful for any person to use any new or reconstructed plant for the production and generation of heat and power, or either of them, until he shall have first procured a certificate from the Smoke Inspector that the plant is so constructed that it will do the work required and that it can be so managed that no dense smoke shall be emitted from the chimney connected with the furnace or firebox.

Sec. 16. No owner shall alter or repair any chimney or any old furnace or device which alteration, change or installation shall affect the method or efficiency of preventing smoke, without first submitting plans and specifications to the Smoke Inspector and securing a permit therefor, provided, however, that minor necessary or emergency repairs which do not increase the capacity of such plant or which do not involve any substantial alteration in structure and which do not involve any alteration in the method or efficiency of smoke prevention may be made by or under the engineer in charge of said plant without a permit. Any person who shall violate this section shall be liable to a fine of \$25.00 for each day upon which he shall prosecute such alteration, change or installation without a permit, and each day's violation shall constitute a separate offense.

Sec. 17. The emission of dense smoke within the city from the smokestack of any locomotive, steam boat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle or other similar machine or contrivance, or from the smokestack or chimney of any building or premises, excepting for a period of six minutes in any one hour during which the fire box is being cleaned out or the fire being built therein, is hereby declared to be a nuisance and may be summarily abated by the Smoke Inspector or by any one whom he may duly authorize for such purpose. Such abatement may be in addition to the fine hereinafter provided. Any person or persons, or corporation, owning, operating or in charge or control of any locomotive, steam boat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance, or of any building or premises, who shall cause or permit the emission of dense smoke, within the city, from the smokestack, or chimney of any such locomotive, steam boat, steam roller, steam derrick, steam pile driver, tar or chimney of any building or premises so owned, controlled or in charge of him, her or them, except for a period of six minutes in any one hour during which the fire box is being cleaned out or a new fire built therein, shall be deemed guilty of a violation of this ordinance, and upon conviction thereof shall be fined not less than ten dollars (\$10.00) nor more than one hundred dollars (\$100.00) for each offense; and each day of such emission of dense smoke shall constitute a separate offense.

Sec. 18. The fees for the inspection of plans and issuing of permits and for the inspection of plants and issuing of certificates shall be as follows:

For inspecting plans of new plants and plants about to be reconstructed, \$2.00.

For inspecting plans for report and alterations, \$1.00.

For examining a plant after its erection or reconstruction and before its operation and maintenance, \$3.00.

The fee paid for the inspection or examination shall include the issuing of a permit or certificate, in case such permit or certificate is granted.

The Smoke Inspector may and he is hereby directed and instructed to remit all inspection or examination fees charged, or that hereafter may be charged, against any and all charitable, religious and educational institutions when the furnace or other device or apparatus inspected is located in or upon premises used and occupied exclusively by such charitable, religious or educational institution; provided, that such charitable, religious or educational institution is not conducted or carried on for private gain or profit; and, provided further, that the Smoke Inspector may require every application for the remission of such fees to be verified by the affidavit of one or more tax payers of the city.

Sec. 19. Prosecutions for all violations of this ordinance shall be instituted by the Smoke Inspector and shall be prosecuted in the name of the City of Chicago.

The issuance and delivery by the Smoke Inspector of any permit or certificate for the construction or reconstruction, or any permit for the alteration or repair of any plant or chimney connected with a plant, shall not be held to exempt any person or corporation to whom any such permit has been issued or delivered, or who is in possession of any such permit, from prosecution on account of the emission or issuance of dense smoke caused or permitted by any such person or corporation.

Sec. 20. Any person who shall violate any of the provisions of this ordinance (except as is herein otherwise provided) shall be fined not less than \$25.00 nor more than \$100.00 for each offense.

Sec. 21. The city shall provide such instruments, books, papers and equipment as shall be necessary for the proper performance of the duties of the members of the department. The Smoke Inspector shall have charge of such instruments, books, papers and equipment, and shall deliver the same to his successor in office.

Sec. 22. The Smoke Inspector shall cause to be kept in his office a complete record of all plans submitted and of all permits issued and of all examinations of plants made by members of the department and also of all certificates issued.

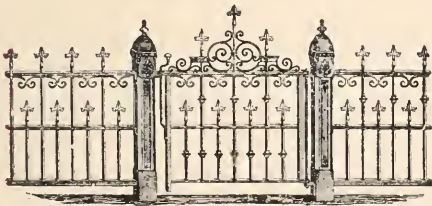
Sec. 23. The Smoke Inspector shall make a report of the work of his department to the Mayor and City Council, annually, on or before the first day of February, and at other times as often as required by the City Council.

Sec. 24. If any person acting on behalf of the city under the provisions of this chapter shall take or receive any money or any valuable thing for the purpose of deceiving or defrauding any person or persons, or for the purpose of favoring any person or persons, or if any inspector shall recommend the issue of any certificate of inspection without having at the time stated thoroughly examined and tested the furnace, device or apparatus so certified, he shall be fined one hundred dollars for each offense.

Sec. 25. Chapter LXIV of the Revised Municipal Code of Chicago of 1905, as amended, so far only as said chapter refers to smoke inspection, is hereby repealed and the position of Chief Smoke Inspector created by said chapter is hereby abolished.

Sec. 26. This ordinance shall take effect on and after its passage and publication.

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SIDEWALKS AND VAULT COVERING.

SYNOPSIS OF SPECIFICATIONS FOR CONCRETE AND STONE SIDEWALKS, AND FOR WALKS LAID OVER VAULTS, ETC., FROM ORDINANCE

PASSED MARCH 23, 1904.

Requirements of the City as to quality of work, etc., must be observed under penalty.
Walks Laid on Filling.

Prepare foundation by cutting down or filling up to a sub-grade 14 inches below final sidewalk grade. Where filling is necessary it shall be of earth or cinders, or other material equally good, free from animal or vegetable matter, placed to leave a berm of one foot on each side of and flush with the top of the completed walk (except where the walks are laid full width of the sidewalk space), and shall slope to the natural surface $1\frac{1}{2}$ feet horizontal to 1 foot vertical. Where necessary the foundation must be compacted until solid. Soft places must be dug out and refilled and thoroughly compacted. Upon this sub-foundation lay cinders, 9 inches in depth after being flooded and thoroughly tamped. Upon this foundation place a layer of hydraulic cement concrete $4\frac{1}{4}$ inches thick, composed as follows:

Concrete Mixed with Sand.

One part of cement equal in quality to the best Portland, $2\frac{1}{2}$ parts of clean torpedo sand, ranging from $\frac{1}{8}$ inch down to the finest, and 5 parts of crushed limestone, or other stone equally as good, or washed gravel, all free from dust and dirt or other foreign substances, and not less than $\frac{1}{4}$ inch or more than 1 inch in any dimension. The cement and sand shall be thoroughly mixed dry, after which it shall be moistened with water and made into a stiff mortar. The crushed stone or gravel to be sprinkled with water, then incorporated in the mortar and the mass thoroughly mixed by turning over with shovels, hoes, or mixers at least three times, and then placed on the foundation and rammed until solid.

The finishing layer, $\frac{3}{4}$ of an inch thick, 2 parts of cement equal in quality to the best Portland and 3 parts clean torpedo gravel or granite screenings put on before the first layer has set, and troweled to give the walk a smooth, even and glossy surface.

Space at Curb: A space of $1\frac{1}{2}$ inches between all walks and the curb at street and alley intersections.

All mixing to be done on water-tight platforms.

All work on 5, 6, 10, 12, 15, 18, 20, 24 and 25 foot walks to be laid out in blocks 5 feet by 6 feet in size; on all other widths the stones to be uniform and to have a surface of not less than 24 square feet nor more than 36 square feet.

All walks to be laid on a line 1 foot from and parallel with the lot line unless ordered by special ordinance.

WALKS LAID OVER VAULTS, ETC.

Beam Work.

Substructure: Steel I beams set not more than 5 feet centers, the outer end to rest 8 inches on curb wall and be firmly bedded in masonry to the top flange. Where practicable the inner end of beam to penetrate the building wall 6 inches. Whenever beams rest on an area wall, and the clear span between bearing points exceeds 9 feet, wall must not be less than 12 inches thick.

Where no area or building wall exists cross beams shall rest on or be framed into a girder beam and fastened to same with proper angles and thoroughly bolted or riveted. All intersecting or girder beams to be 1 inch deeper than the cross beams, which are to rest on or be framed into them.

Said girder beams to be supported by circular cast iron columns, not more than $8\frac{1}{2}$ feet apart from centers, and not less than 5 inches external diameter and metal not less than $\frac{1}{2}$ inch thick, free from blow-holes and defects.

Columns to rest on 12 by 12 inch iron plates 1 inch thick, firmly bedded in a concrete foundation not less than 18 inches thick and having a surface bearing not less than 4 square feet. The top of column shall have a square plate 1 inch thick, fitted with a shoe formed in same, in which the girder beam shall rest. Columns over 10 feet to be $\frac{3}{4}$ inch metal, and 6 inches external diameter.

The top of the completed iron substructure shall be parallel with and 4 inches below top of finished walk.

The following sized steel cross beams shall be used:

Span in Feet.	Beams Deep in Inches.	Weight per Ft., lbs.
6 and 7	6	12 $\frac{3}{4}$
8	7	15
9 and 10	8	17 $\frac{3}{4}$
11 and 12	9	21 to 25
13	10	25
14, 15 and 16	12	31 $\frac{1}{2}$
17 and 18	12	40
19 and 20	15	42

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If necessary to change spacing between beams or use a beam of different depth than specified, the spacing shall be so changed, or such beam shall be of sufficient weight to give it bearing strength equal to the beam specified.

Concreting: Between the beams set in place and securely fastened to the lower flange, shall be placed temporary centers, smooth on the upper surface, which shall be removed when the concrete is set, the top or crown of same shall be two inches below the top of the steel cross beams.

Upon the above forms shall be placed the concrete, composed of the same kind of material, in the same proportions, etc., as the concrete specified for sidewalks, especial care being given to tamping and ramming, and brought to a grade three inches above the top of the steel substructure and 1 inch below and parallel with the top of the completed walk. The finishing layer, 1 inch thick, composed of two parts of cement, equal in quality to the best Portland, and 3 parts screened torpedo gravel, or granite screenings, to be put on before the first layer has set, and troweled sufficiently to give the walk a smooth, even and glossy surface, joints to be formed over the center of each I beam in the concrete as well as in the top dressing, and extend over the curbing down to the pavement.

Any system or method of vault construction equal to the above system may be used in lieu thereof, but in all cases any plans calling for beams or a construction of a size or character different from the above sizes and weights must be submitted to the Commissioner of Public Works for approval before construction is commenced and must be capable of sustaining a distributed safe load of 300 pounds per square foot, including weight of walk.

A stamp or plate giving the name and address of the contractor or person building the walk and the year in which the work was done. The top of said plate or stamp must not cover more than 54 square inches of surface, shall be flush and even with the top of the finished walk and must be of a permanent character.

Wherever one contractor or person has laid walks in front of three or more adjoining lots in one stretch, one of the stamps placed at each end of stretch of walk will be sufficient.

Slope: All sidewalks to be so constructed that the grade shall be a uniform incline, with a fall of 1 inch in every 3 feet.

Curbage: The curbage shall have a top dressing 1 inch thick, and shall extend 4 inches below the top of the pavement. When finished it shall present a true and perfectly plumb appearance; all joints to be straight and clean cut.

Driveways shall conform to the sidewalk grade and shall be 9 inches in depth, consisting of a layer of concrete 7 inches in depth and a finishing layer of 2 inches. Work to be as specified for Portland concrete walks.

Stone Sidewalks shall be constructed of the best quality of limestone, quarried a sufficient time to be seasoned and thoroughly frost proof. Stone to be free from cracks, etc., sawed or planed, with full joints grooved for $1\frac{1}{4} \times \frac{3}{8}$ inch iron bars, the ends to be full and heads dressed to a uniform thickness. No stone to be less than $4\frac{1}{2}$ feet wide and of the following thicknesses:

For walks 8 feet wide the stone shall be not less than 6 inches thick.

For walks 10 feet wide the stone shall be not less than 8 inches thick.

For walks 12 feet wide the stone shall be not less than 10 inches thick.

For walks 14 feet wide the stone shall be not less than 12 inches thick.

For walks 16 feet wide the stone shall be not less than 14 inches thick.

Stones to be bedded on the curb wall on the outside and inside on 6x8 inch iron lintels of $1\frac{1}{4}$ inch metal, supported by circular cast iron columns not less than 8 feet in length set not more than 8 feet apart from centers; on foundation of stone not less than 12 inches deep, and having a surface bearing of not less than 4 square feet. Columns to be of the best quality of cast iron, free from all defects, of the following sizes external diameter:

For walks 8 feet wide or less 4 inch columns of $\frac{1}{2}$ inch metal.

For walks 10 feet wide or less 5 inch columns of $\frac{1}{2}$ inch metal.

For walks 12 feet and over 6 inch columns of $\frac{1}{2}$ inch metal.

Columns over 10 feet in length shall be of $\frac{3}{4}$ inch metal and 1 inch greater in external diameter than the sizes specified above.

All joints in the walk to be made water tight by caulking with oakum and pitch.

Slope: All sidewalks to be so constructed that the top surface shall coincide with the grade of the space between the curb line and the street line, which grade shall be a uniform incline from the street line toward the curb line, with a fall of 1 inch in every 3 feet.

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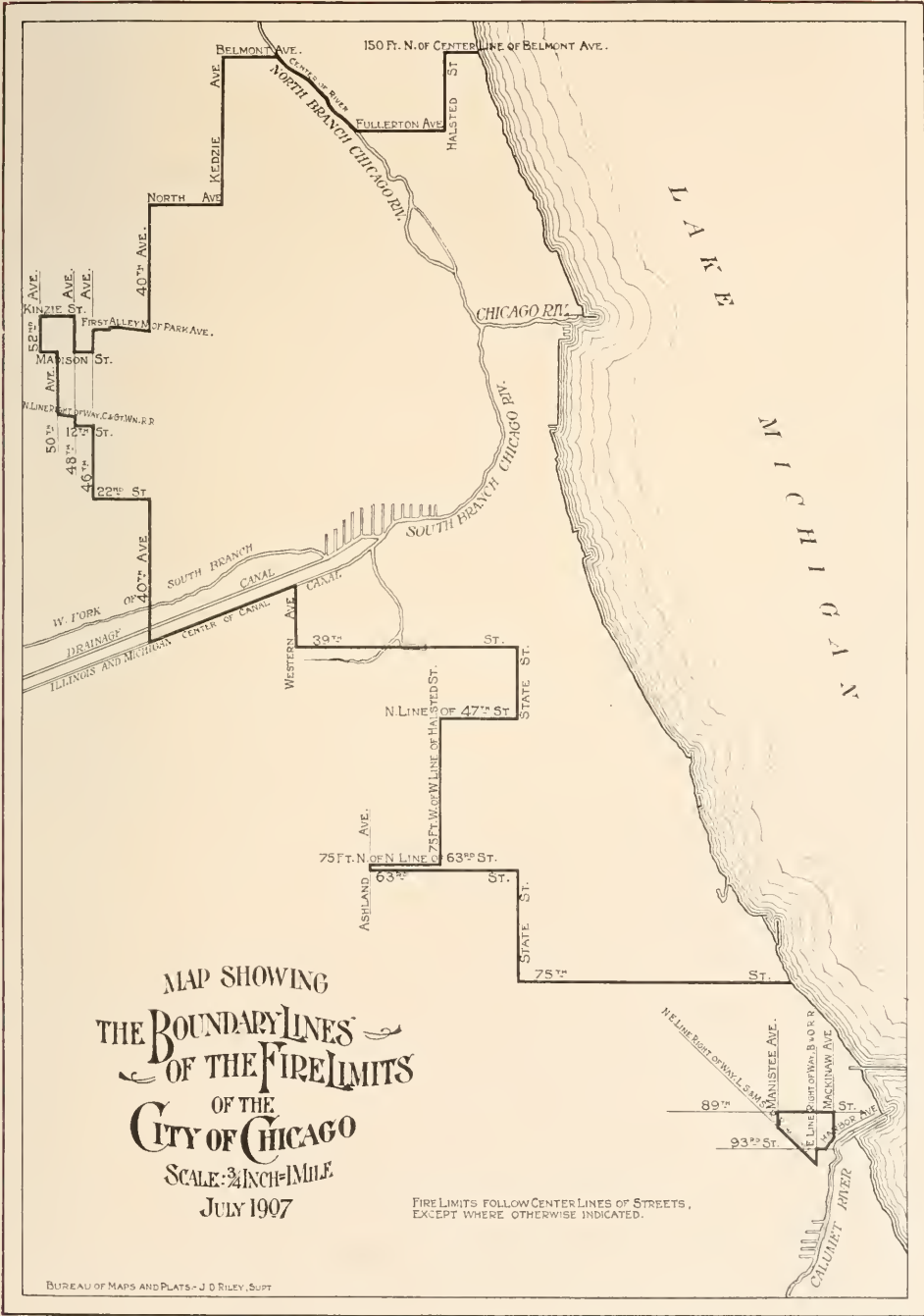
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CHICAGO

MAP SHOWING THE BOUNDARY LINES OF THE FIRE LIMITS OF THE CITY OF CHICAGO.





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SPECIFICATIONS FOR STANDARD HOLLOW TILE FIREPROOFING.

GENERAL.—The contractor for this work will be required to furnish all the material and labor of every description required to erect the same in place complete. The contractor is referred to the plans and details for the general construction, and especially the steel diagrams and details showing connection between the structural steel and tile work.

SPECIAL SHAPES.—The contractor shall furnish all necessary special shapes for the proper fitting to the steel work.

DETAILS.—When requested to do so the contractor shall furnish large scale details or full sized drawings for all special shapes, column coverings, lintel covers, girder covers, and general type of arch, which shall be submitted to the architects for their approval.

SCAFFOLDING, TOOLS, ETC.—Furnish all the tools, machinery, hoisting apparatus and centering necessary to carry on the work at the rate of progress stipulated in the contract.

TILE.—All the tile required for this work shall be of the best quality of hard burned fire clay, semi-porous, or porous terra cotta. This tile to be well manufactured, no badly split, cracked or warped tile will be permitted to go into the work.

MORTAR AND LAYING.—All tile work for the floor construction shall be laid in mortar composed of one (1) part American Portland Cement, of approved brand, four (4) parts sharp sand and one part (1) lime mortar, all thoroughly well mixed together as follows: The sand and cement are to be mixed together dry and sufficient water added to thoroughly wet the same, after which the lime mortar is to be added and the whole mass is then to be thoroughly tempered. All other tile work is to be laid in mortar composed as follows: One (1) part Louisville, Rosendale, or other natural cement, three (3) parts sharp sand and one part lime mortar, thoroughly mixed in the manner before described. All tile must be laid with full flush joints, plumb, to a line, with horizontal beds uniformly level on each course. Fill all the joints, chinks and crevices between the tile and steel work with mortar well slushed in.

TYPE OF ARCH.—The arches for the floors in general shall be ——— inch; flat or segment arches, with side or end construction. Skewbacks carefully bedded in place against beams.

BEAM TILE.—The soffits of all beams to be protected with slabs of tile at least 1 inch in thickness. If more than one inch, the beam tile must be made with air space next to beam.

ROOFS.—The arches for the main roof are to be ——— in segment or flat arches same as specified for the floors.

MINOR ROOFS.—The roofs of pent houses, roof over projecting portion in second story, floor of bulkheads, and other portions indicated on details as book-tile shall be made of three-inch (3 in.) book-tile set in place between tee-irons. Tee-irons to be furnished by the iron contractor.

PARTITIONS.—All partitions shown on the plans to be built the thickness indicated in figures. If no dimensions are given, the following sizes will govern:

Partitions for all corridors and for partitions over 12 feet and up to 14 feet in height to be 4 inches. Partitions over 14 feet in height to be 6 inches, and all cross partitions 12 feet or less to be 3 inches. Partition walls to be built straight, true, plumb and well bonded with proper "breakjoint" bond on each alternate course, and all joints thoroughly flushed up with mortar, and to be well wedged underneath.

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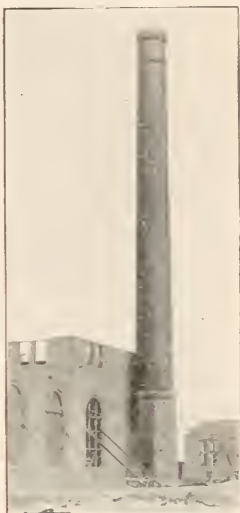
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FURRING TILE.—Where indicated on plans, 2 inch furring tile are to be built against the outside walls of the building. These tiles are to be secured to the brick walls with 10d spikes on every third course, driven into the brickwork at intervals not greater than 48 inches apart.

CURB WALL.—The curb wall in basement shall be furred with three-inch (3 in.) tile extending up to the under side of the iron plate along edge of curb wall and properly fitting around all beams.

ROUGH FRAMES AND BLOCKS.—The contractor for carpenter work will furnish and erect the rough wood frames at all openings in partitions and furring. He will also furnish all wooden blocks necessary to form nailing facilities for attaching plaster grounds, etc. These blocks must be built in place by fireproofing contractor wherever directed by the architect.

COLUMN COVERING.—All column covering shall start, in all cases, directly from the tile arches of floor. Column covering shall be designed to properly fit the columns.

All corners of square columns shall be left square or round. Column covering to be wired on once or twice in each course in height or secured together with clamps.

COVERING EXPOSED STEEL WORK.—All girders, beams, channels, etc., that show below the under side of ceilings are to be encased on all sides with at least 1-inch thickness of fire-proof tile secured to the steel in the usual manner. If required, special designs must be submitted to the architect.

BOXES FOR PLUMBING PIPES.—All soil, vent, down spout and water supply pipes shall be boxed in, using three-inch (3 in.) tile, starting from the floor tile in all cases. This boxing shall not be done until the pipes have been properly tested, and covered by another contractor. There shall be no openings into boxes except for outlets on the various floors. Where these outlets occur small wood frames furnished by carpenter shall be set by the fireproofing contractor.

BULKHEADS.—All bulkheads of first and second floor shall be built of 3-inch tile; the structural iron contractor furnishing all necessary tee-irons for the support of the tile. See details for bulkhead treatment, and iron drawings for the supports.

Provide three-inch (3 in.) tile for the ends of bulkheads where intersected by the entrance doors.

TOILET ROOM FLOORS.—All toilet room floors where shown on plans shall be raised approximately one foot with fireproofing. Supports to be so arranged as not to interfere with the piping of these rooms.

PENT HOUSES.—The contractor shall build the walls of pent houses with four-inch (4 in.) hard or glazed tile, laid up in Portland cement mortar, all joints to be thoroughly flushed up.

Curbs of all skylights shall be built of four-inch tile.

FLOOR STRIPS AND CONCRETE FILLING.—After the floor arches have been set in place, and at such times as may be designated by the architect, the contractor for carpenter's work will furnish and set the 2x3-inch wood floor strips required as nailing ground for the finished wood flooring, where wooden flooring is called for.

After the strips have been set, the fireproofing contractor must fill in between the same with concrete filling; this concrete is to be composed of one (1) part American Portland Cement, of approved brand, two (2) parts sharp sand, and six parts broken tile, stone, gravel or fine, clean coal cinders, thoroughly mixed together dry, then tempered and mixed, and tamped in place. In no case shall cinder concrete be allowed to come in contact with structural steel.

FINALLY.—Do everything necessary to finish the entire work in a thorough and substantial manner. Remove promptly from the premises all the tools, scaffolding, unused tile, debris, etc., as soon as the work is completed.



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DEPARTMENT OF ELECTRICITY.

CITY OF CHICAGO.

NOTICE.

Particular attention is called to the different sections of the ordinance herein printed:

Permit must be obtained before any work is done.

The use of electric current is prohibited previous to certificate being issued.

Conditions unsafe to life or property must be corrected within forty-eight hours.

Each building must have independent service from street or alley.

Wires must not pass through party walls, over roofs or under sidewalks.


Current must not be supplied from trolley lines for motors or light except for power stations owned by company.

Temporary work must be inspected and approved before current is used.

Alterations to existing wiring must not be made without regular permit.

Permits issued by the Commissioner of Public Works for electrical work to be done on streets must be countersigned by the Department of Electricity.

Violation of any of the Sections of this ordinance constitutes a misdemeanor and renders any person, firm or corporation liable to arrest and fine of not less than \$50 or more than \$100, also the cutting off and stopping of current used in violation until the provisions are complied with.


City Electrician.

SPECIAL SUGGESTIONS TO ARCHITECTS.

The Department of Electricity will not allow more than twelve (12) sockets to be attached to one circuit.

Architects are urged to make definite specifications for electrical work, for the benefit of both the electrical contractor and the fixture contractor, specifying the number of outlets in each job for the electrical contractor to follow, and the exact number of 16-candlepower lamps to be used.

Frequently the fixture contractor installs more than twelve lights on a circuit, which is in violation of the city ordinances, and causes the consumer very much annoyance in getting electric current to his premises.

It is also suggested that the architects demand of the electrical contractor that he make up all connections and combinations relative to switches, complicated outlets, etc., leaving only two wires for the fixture hanger to make his fixture connections.

GENERAL SUGGESTIONS.

In all electric work conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring special attention must be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, taping of conductors and securing and attaching of fittings, are especially conducive to security and efficiency, and will be strongly insisted on.

In laying out an installation, except for constant-current systems, the work should, if possible, be started from a center of distribution, and the switches and cutouts, controlling and connected with the several branches, be grouped together in a safe and easily accessible place, where they can be readily got at for attention or repairs. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

The use of the wire-ways for rendering concealed wiring permanently accessible is most heartily indorsed and recommended; and this method of accessible concealed construction is advised for general use.

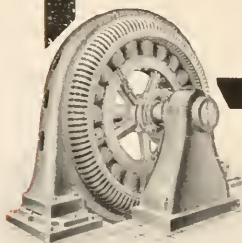
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Architects are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light or power wires, and in specifications for electric gas lighting to require a two-wire circuit, whether the building is to be wired for electric lighting or not, so that no part of the gas fixtures or gas piping be allowed to be used for the gas-lighting circuit.

SPECIAL NOTICE.

Place all service switches, meters and cut-outs, when practicable, in basements or public places where they will be readily accessible to inspectors, meter readers and trouble men, in order to obviate the necessity of interfering with tenants of apartments. It often occurs that tenants of apartment buildings who are not using electric current are annoyed by the visits of inspectors and trouble men in their necessary duties in making inspections or repairs for other tenants.

The placing of meters in basements or halls will largely do away with the annoyance caused by their disagreeable humming and it will be much more satisfactory to all concerned.

SECTIONS OF THE REVISED CODE OF THE CITY OF CHICAGO, GOVERNING ELECTRICAL INSPECTIONS.

March 20, 1905.

CHAPTER XXII—DEPARTMENT OF ELECTRICITY.

807. Electric Current.—No electric current shall be used for illumination, decoration, power or heating, except as hereinafter provided.

808. Application—Contents—Permits.—All persons or corporations desiring to install wires or other apparatus for the use of electric currents for any of the purposes mentioned in the foregoing section shall, before commencing or doing any electrical construction work of any kind whatever, either installing new electrical apparatus or repairing apparatus already in use, file an application for a permit therefor in the office of the City Electrician, which application shall describe in detail such material and apparatus as it is desired to use, with a full description of the same, giving the locality by street and number; and upon receipt of which application, if found proper, such permit shall be given.

809. Duties of City Electrician Thereon.—The said City Electrician shall have power, and it shall be his duty, when by him deemed necessary, to carefully inspect any such installation previous to and after its completion, and it shall be competent for him to remove any existing obstructions which may prevent a perfect inspection of the current carrying conductors, such as laths, plastering, boarding or partitions; and if such installation shall prove to have been constructed in accordance with the rules and regulations of the Department of Electricity, controlling the use of electric current, upon the payment of a fee, as herein provided, he shall issue a certificate of such inspection, which shall contain a general description of the installation and the date of such inspection. Any owner installing or causing to be installed any electric wires to be hidden from view shall, prior to such installation, give said city electrician a reasonable notice in order to give ample time for inspection. The use of electric current is hereby declared to be unlawful previous to the issuance of such certificate; provided, however, the City Electrician may issue a temporary permit for the use of electrical current during the course of construction or alteration of buildings, which permit shall expire when the electrical apparatus for such building is fully installed.

810 Preliminary and Final Certificate.—A preliminary certificate may be issued by said City Electrician, in the case of completed installations, but upon which no current shall be used in the immediate future. Such preliminary certificate shall show that at the date of inspection the installation was erected in accordance with the terms of this chapter, and shall be issued at one-half the rates hereinafter named. Prior to the introduction of electric current into the said premises a second inspection shall be made, when, if the said installation is still in accordance with the terms of this chapter, a complete and final certificate shall issue, and the amount of the fee paid for the preliminary certificate shall be deducted from the fee for the final certificate.

§11. Power of City Electrician — Inspections and Re-inspections.—The said City Electrician is hereby empowered to inspect or re-inspect all overhead, underground and interior wires and apparatus conducting electric current for light, heat or power, and when said conductors or apparatus are found to be unsafe to life or property, he shall notify the person or corporation owning, using or operating them to place the same in a safe and secure condition within forty-eight hours. Any person or corporation failing or refusing to repair, change or remove the same within forty-eight hours, or within such further time as the city electrician shall determine is necessary, after the receipt of such notice, shall be subject to the penalty hereinafter provided.

§12. Poles—Covers—Wires—Electric Service Entrances—Switches.—All poles now standing or hereafter erected, and all covers for manholes now in service, or hereafter placed in service for the use of electric conductors, shall be branded or stamped with the name of the person or corporation owning the same; all electric service entrances shall have attached to the conductor or conductors, in a conspicuous place, a substantial tag designating the owner, and giving such a full description of the conductors as shall meet with the approval of said City Electrician; and all of said electric service entrances shall be properly equipped with approved cut-out service switches. Each building into which electric current shall hereafter be introduced shall have independent service from the street or alley, entering at right angles with the street curb, except where the service wires are placed in conduits complying with the rules of the department of electricity; and no wires hereafter put up shall pass from one building to another through any party wall or along any building wall or over any roof or under any sidewalk, except where such conduits are used. No electric current shall be supplied from any trolley line for any purpose whatever to any building except for lighting the power stations from which current is supplied to such trolley lines.

§13. Fees.—There shall be collected by the City Collector, prior to the issuance of certificates permitting the use of electric current, the following fees, in the following manner:

For the inspection of each of the first two arc lamps, one dollar; for each of the next three arc lamps, eighty cents; for each of the next five arc lamps, seventy cents; for each of the next ten arc lamps, sixty cents; for each of the next ten arc lamps, fifty cents; for each additional arc lamp above thirty, twenty-five cents.

Incandescent lamps of nominal 16 candlepower, and for larger or smaller lamps in that proportion, as follows:

For each of the first twenty-five incandescent lamps, ten cents; for each of the next twenty-five lamps, nine cents; for each of the next twenty-five lamps, eight cents; for each of the next twenty-five lamps, seven cents; for each of the next one hundred lamps, six cents; for each of the next one hundred lamps, five cents; for each additional lamp above three hundred, four cents.

For each electrical horse-power of 746 Watts, used for mechanical or other purposes than above mentioned, the sum of one dollar for each horse-power from one to five horse-power, inclusive.

For each of the next succeeding 5 horsepower, seventy-five cents; for each of the next succeeding 5 horsepower, sixty-five cents; for each of the next succeeding 10 horsepower, fifty-five cents; for each of the next succeeding 25 horsepower, fifty cents; for each additional horsepower, twenty-five cents. No inspection shall be made for a less amount than one dollar.

Inspections of temporary installations for show-window exhibitions, conventions and the like, shall be charged for by the time required for such inspections at the rate of fifty cents per hour.

Each re-inspection of any overhead, underground or interior wires or apparatus, shall be charged for by the time required for such re-inspection at the rate of fifty cents per hour.

ARC LAMPS.

2 arc lamps at \$1, \$2; above 2 lamps to 5.....	at 80 cents each
5 arc lamps, \$4.40; above 5 lamps to 10.....	at 70 cents each
10 arc lamps, \$7.90; above 10 lamps to 20.....	at 60 cents each
20 arc lamps, \$13.90; above 20 lamps to 30.....	at 50 cents each
30 arc lamps, \$18.90; above 30 lamps.....	at 25 cents each

INCANDESCENT LAMPS.

25 lamps, \$2.50; above 25 to 50 lamps.....	9 cents each
50 lamps, \$4.75; above 50 to 75 lamps.....	8 cents each
75 lamps, \$6.75; above 75 to 100 lamps.....	7 cents each
100 lamps, \$8.50; above 100 to 200 lamps.....	6 cents each
200 lamps, \$14.50; above 200 to 300 lamps.....	5 cents each
300 lamps, \$19.50; above 300.....	4 cents each

MOTORS.

5 horse power, \$5; above 5 to 10 horse power.....	at 75 cents
10 horse power, \$8.75; above 10 to 15 horse power.....	at 65 cents
15 horse power, \$12; above 15 to 25 horse power.....	at 55 cents
25 horse power, \$17.50; above 25 to 50 horse power.....	at 50 cents
50 horse power, \$50; above 50.....	at 25 cents

Immediately after the inspection provided for in Section 809 the City Electrician shall make a fee bill, in duplicate, on a form to be approved by the City Comptroller, and shall forward the same to the comptroller to be recorded and rendered. The person or corporation receiving the fee bill shall pay the amount thereof to the city collector, who shall endorse payment thereon, and enter the fee bill and payment in a book in his office to be provided for that purpose and thereupon the City Collector shall deliver the paid fee bill to the person or corporation paying the same. The paid fee bill shall then be presented to the City Electrician at his office, who shall thereupon issue the preliminary of final certificate, provided for in Section 810.

814. Alterations.—No alterations shall be made in any electrical installation without first notifying the said City Electrician and submitting the same for inspection in the same manner as provided for new work.

815. Penalty.—Any person or corporation furnishing or using any electric current within the city, in violation of any of the provisions of this chapter, or contrary to any of the rules and regulations of the Department of Electricity, shall be fined not less than fifty dollars nor more than one hundred dollars for each offense, and each day's use thereof contrary to the provisions of this chapter shall constitute and be a separate and distinct offense. Said City Electrician may, for any violation of the provisions of this Chapter, also order and compel the cutting off and stopping of such current until the provisions of this Chapter are fully complied with.

Table of Carrying Capacity of Wires.

B. & S. G.	Concealed Work. Amperes.	Open Work. Amperes
18.....	3	
16.....	6	
14.....	12.....	19
12.....	17.....	24
10.....	24.....	32
8.....	33.....	43
6.....	46.....	57
5.....	54.....	63
4.....	65.....	74
3.....	76.....	83
2.....	90.....	98
1.....	107.....	117
0.....	127.....	140
00.....	150.....	157
000.....	177.....	185
0000.....	210.....	225

Table of Carrying Capacity of Wires.—Continued.

Circular Mills.	Concealed Work. Amperes.	Open Work. Amperes.
200,000.....	200.....	
250,000.....		285
300,000.....	270.....	355
350,000.....		377
400,000.....	330.....	415
500,000.....	390.....	485
600,000.....	450.....	545
700,000.....	500.....	600
800,000.....	550.....	655
900,000.....	600.....	710
1,000,000.....	650.....	765
1,100,000.....	690.....	
1,200,000.....	730.....	
1,300,000.....	770.....	
1,400,000.....	810.....	
1,500,000.....	850.....	
1,600,000.....	890.....	
1,700,000.....	930.....	
1,800,000.....	970.....	
1,900,000.....	1,010.....	
2,000,000.....	1,050.....	

The lower limit is specified for rubber-covered wires to prevent gradual deterioration of high insulations by heat of wires, but not from fear of igniting the insulation. Question of drop is not taken into consideration in above tables.

The carrying capacity of sixteen and eighteen wire is given, but no smaller than fourteen is to be used, except as allowed under Rules 24 *u* and 40 *c*.

Materials.

The following is a list of non-combustible, non-absorptive, insulating materials for the benefit of those who might consider hard rubber, fiber, wood and the like as fulfilling the requirements.

1. Glass.
2. Marble (filled).
3. Slate without metal veins.
4. Porcelain, thoroughly glazed and vitrified.
5. Pure Sheet Mica.
6. Lava (certain kinds of).
7. Alberene Stone.

Electric Gas Lighting—

Electric gas lighting must not be used on the same fixture with the electric light.

§16. **Electric Lighting Facilities Indemnity.**—The city electrician is authorized to execute and deliver in the name of the city of Chicago to any person or corporation affording facilities for any of the city's electric lighting property, contracts of indemnity to hold such person or corporation harmless from all injuries, damages or expense to any persons or property arising in any way out of the city's exercise of such facilities, when such facilities are not afforded under the requirements of ordinances held by them.

§18. **City Electrician in Control.**—The City Electrician shall have charge and control of and shall erect all lamp posts and lamps, and street signs designating the names of the streets which shall be placed on said lamps.

REGULATIONS GOVERNING CHICAGO EDISON COMPANY'S SYSTEM.

INSPECTION.

All wiring which is to be connected to the mains of this Company must be installed in accordance with the rules and requirements of the Department of Electricity of the City of Chicago and the Chicago Underwriters' Association. A "certificate for installation" or "temporary current permit" from said Department of the City must be presented at the office of the Inspection Department of this Company before current can be used on any wiring for which such certificate or current permit has not been issued. When wiring has been installed for additional lights or power, this certificate or current permit must also be presented as in the case of an original installation. The Company should be notified whenever any additional apparatus is desired to be connected to consumer's wiring in order to avoid interruption of consumer's service and injury to the Company's meters or other apparatus. The Company will make the final connection of all wiring to its mains.

DIRECT CURRENT TERRITORY.

Current is supplied from the Edison three-wire direct current system in approximately the following territory:

South of Menomonee Street east and north of the Chicago River.

West from the Chicago River to Morgan Street between Kinzie Street and Twenty-second Street, except on Milwaukee Avenue, where the direct current extends to Wood Street; on West Madison, where it extends to Ashland Ave., and on Blue Island Avenue, where it extends to Throop Street.

In the "down town" district. On the south side to Thirty-fifth Street between Stewart Avenue and Cottage Grove Avenue.

From Thirty-fifth to Thirty-ninth between Dearborn Street and Grand Boulevard, and on Cottage Grove Avenue from Thirty-fifth to Thirty-eighth Streets.

ALTERNATING CURRENT TERRITORY.

Current is supplied from the alternating current Edison three-wire system for lighting and small power in all parts of the City, other than those above described, where the Company has lines.

Current is supplied for power from the three-phase system in a large part of the alternating territory, but inquiry should be made of the Inspection Department at the nearest district office as to the proximity of three-phase lines to any particular location where power may be desired.

SERVICES.—UNDERGROUND.

The consumer's wiring must be extended to the Company's nearest service where sidewalks are excavated and provided with the necessary service switch and cut-outs, unless the premises in which current is to be used are more than 50 feet from the nearest service. In this case, application should be made to the Company to have a service installed.

In case it is necessary to extend service inside of the property line in order to reach the building, the expense of the installation of the portion inside the property line must be borne by the consumer. Final connection of the wiring to the service will be made by this Company in all cases.

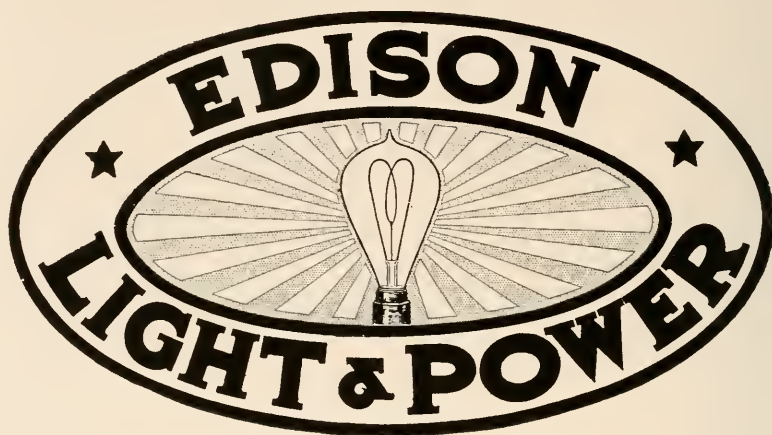
OVERHEAD.

The consumer's wiring must be brought outside the building wall at some point at least 25 feet above the ground, so located that it will be readily accessible to service wires brought from the Company's nearest pole. In case the pole line from which service is to be given is not in position at the time interior wiring is being done inquiry should be made at the district office for information as to its proposed location.

Inside wiring must not be brought out of the building in an inclosed air shaft, as the City ordinance forbids the erection of wires across a roof to reach wires in such a place.

The location of service outlets on a party wall is also forbidden by City ordinances.

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ALTERNATING CURRENT MOTOR AND ARC LAMP.

On the alternating current system, separate services will be provided as follows:

For motors of one horse-power or larger and for arc lamps where a large installation is made.

Inquiry should be made of the Inspection Department in all cases where more than ten alternating arc lamps are being wired, as to whether incandescent and arc lamps may be wired to the same service.

Separate mains and meter loops are of course necessary for all wiring fed by separate services.

METERS.

Meter loops must be provided in the mains at an accessible point, and so arranged that the meter may be mounted with ordinary wood screws on the wall. A meter board must be provided of sufficient size to allow the installation of a recording watt meter and maximum demand meters. Two demand meters are installed on three-wire mains. Sufficient space must be provided about the meters to allow the removal of the case. Meter loops should not be placed above seven feet from the floor.

In office buildings meter loops should be located at a central point in meter closets or public corridors, and in apartment buildings in the basement of the building, so that meters may be installed and maintained without annoyance to tenants.

MOTORS.

Wiring for motors should be so arranged that the current used for power purposes may be metered separately from that used for lighting. Wiring for elevators should also be arranged so that current used on elevators may be metered separately from that used for other power.

All motors larger than 1 horsepower must be wound for 220 volts, and it is preferred that motors of three-fourths horsepower and larger be so wound.

Alternating current motors must be designed to operate at a frequency of 60 cycles.

No motors larger than 5 horsepower will be supplied on single-phase system, except by special permission, given by the Inspection Department of the company in each case.

Motors of 5 horsepower and larger will be supplied on the three-phase system at 60 cycles, 220 volts.

No motor will be connected which requires more than three times full load current in starting without load.

INCANDESCENT LAMPS.

Standard shape Edison base incandescent lamps will be furnished free of charge for installations and renewals, unless otherwise provided for by the terms of the contract, in 4, 8, 10, 16, 24, 32 and 50 candle-power sizes.

One lamp will be furnished for each socket installed in the customer's premises at the time the installation is made. Additional lamps will be furnished at any time when additional sockets have been wired. A reserve supply of lamps, equal to approximately 10 per cent of the customer's total installation, will be advanced for convenience in making renewals. When burned out or blackened, lamps will be renewed free of charge (except special lamps) upon presentation of the old lamps with glass intact at the nearest lamp renewal station.

All lamps furnished for installation, reserve or renewal remain the property of the company. The consumer must, therefore, give his receipt for all lamps delivered to him for installation, reserve or renewal, agreeing to pay for lamps unaccounted for at 20 cents each.

ARC LAMPS.

Arc lamps having a standard black finish are provided by the company for the consumer's use free of charge. Lamps having ornamental finish will be supplied only at an extra charge.

Lamps furnished by the company will be cleaned and trimmed by the company free of charge when used for general lighting purposes. Arc lamps used for photographing or other purposes than general illumination must be provided and maintained at the consumer's expense. A hanger board must be provided for use in hanging inside lamps and a suitable crane provided with a hook must be provided for outside lamps. They must be installed so that the bottom of the lamp will not be less than eight feet above the ground when it is hung, the length of the lamps being about 40 inches. If it is necessary to install lamps beyond the reach of a six-foot step-ladder, some arrangement must be made for lowering the lamp so that it may be trimmed.

See section on "Services" for special regulations regarding alternating arc lamps.

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GAS FITTERS' RULES

Of the Peoples Gas, Light and Coke Company.

OFFICE BUILDINGS, DWELLING HOUSES AND FLATS.

MANUFACTURED GAS FOR LIGHT.

The following tables show the proportionate size and length of tubing allowed:

Size of Tubing.	Greatest Length Allowed.	Greatest Number of $\frac{3}{4}$ " Openings Allowed.	Size of Tubing.	Greatest Length Allowed.	Greatest Number of $\frac{3}{4}$ " Openings Allowed.
$\frac{3}{8}$ inch	20 feet	2 openings	$1\frac{1}{2}$ inch	150 feet	60 openings
$\frac{1}{2}$ inch	30 feet	3 openings	2 inch	200 feet	100 openings
$\frac{3}{4}$ inch	60 feet	10 openings	$2\frac{1}{2}$ inch	200 feet	200 openings
1 inch	70 feet	15 openings	3 inch	300 feet	300 openings
$1\frac{1}{4}$ inch	100 feet	30 openings			

Drops in double parlors, large rooms and halls of office buildings must not be less than $\frac{1}{2}$ inch.

STORES, HOSPITALS, SCHOOLS, FACTORIES, ETC.

MANUFACTURED GAS FOR LIGHT.

Size of Tubing.	Greatest Length Allowed.	Greatest Number of $\frac{1}{2}$ " Openings Allowed.	Size of Tubing.	Greatest Length Allowed.	Greatest Number of $\frac{1}{2}$ " Openings Allowed.
$\frac{1}{2}$ inch	20 feet	1 opening	$1\frac{1}{4}$ inch	100 feet	20 openings
$\frac{3}{4}$ inch	60 feet	8 openings	$1\frac{1}{2}$ inch	150 feet	35 openings
1 inch	70 feet	12 openings	2 inch	200 feet	50 openings

For stores the running line to be full size to end of last opening.

All drops to be $\frac{1}{2}$ inch with set not less than 4 inches.

Twenty feet of $\frac{3}{8}$ -inch pipe allowed only for bracket lights.

BUILDING SERVICES.

In running service pipe from front wall to meters the following rules will apply:

Size of Opening.	Greatest Length Allowed.	Greatest Number of $\frac{1}{4}$ " Openings Allowed.	Size of Opening.	Greatest Length Allowed.	Greatest Number of $\frac{1}{4}$ " Openings Allowed.
1 inch	70 feet	1 opening	$1\frac{1}{2}$ inch	150 feet	5 openings
$1\frac{1}{4}$ inch	100 feet	3 openings	2 inch	200 feet	8 openings

All openings in service must be equal to the size of riser, which in no case must be less than $\frac{3}{4}$ inch.

MANUFACTURED GAS FOR FUEL.

Size of Tubing.	Greatest Length Allowed.	Greatest Number of $\frac{3}{4}$ Openings Allowed.	Size of Tubing.	Greatest Length Allowed.	Greatest Number of $\frac{3}{4}$ Openings Allowed.
$\frac{3}{4}$ inch	50 feet	1 $\frac{3}{4}$ -in. or 2 $\frac{1}{2}$ -in.	$1\frac{1}{2}$ inch	150 feet	7 or 4 $\frac{3}{4}$ -in. and 6 $\frac{1}{2}$ -in.
1 inch	70 feet	2 or 1 $\frac{3}{4}$ -in. and 2 $\frac{1}{2}$ -in.	2 inch	200 feet	15 or 8 $\frac{3}{4}$ -in. and 14 $\frac{1}{2}$ -in.
$1\frac{1}{4}$ inch	100 feet	4 or 2 $\frac{3}{4}$ -in. and 4 $\frac{1}{2}$ -in.			

For mantels, grates and small heating appliances, for heating space not to exceed 1,728 cubic feet, thirty feet of $\frac{1}{2}$ -inch pipe is allowed for one opening only, and two such openings are considered as one $\frac{3}{4}$ -inch opening.

FOR GAS ENGINES.

Size of Engine.	Size of Opening.	Greatest Length Allowed.	Size of Engine.	Size of Opening.	Greatest Length Allowed.
1 H. P.	1 inch	60 feet	7 H. P.	$1\frac{1}{2}$ inch	100 feet
2 H. P.	$1\frac{1}{4}$ inch	70 feet	12 H. P.	2 inch	140 feet
5 H. P.	$1\frac{1}{2}$ inch	100 feet			

Supply for gas engine must be separate, and an independent service will be required.

NATURAL GAS FOR FUEL.

Classification of Appliances.	Size of Openings.	Greatest Length Allowed.
Small portable gas cooking stove.....	$\frac{1}{2}$ inch	20 feet
Small portable gas heating stove.....	$\frac{1}{2}$ inch	20 feet
Kitchen boiler heater when separated from range.....	$\frac{1}{2}$ inch	20 feet

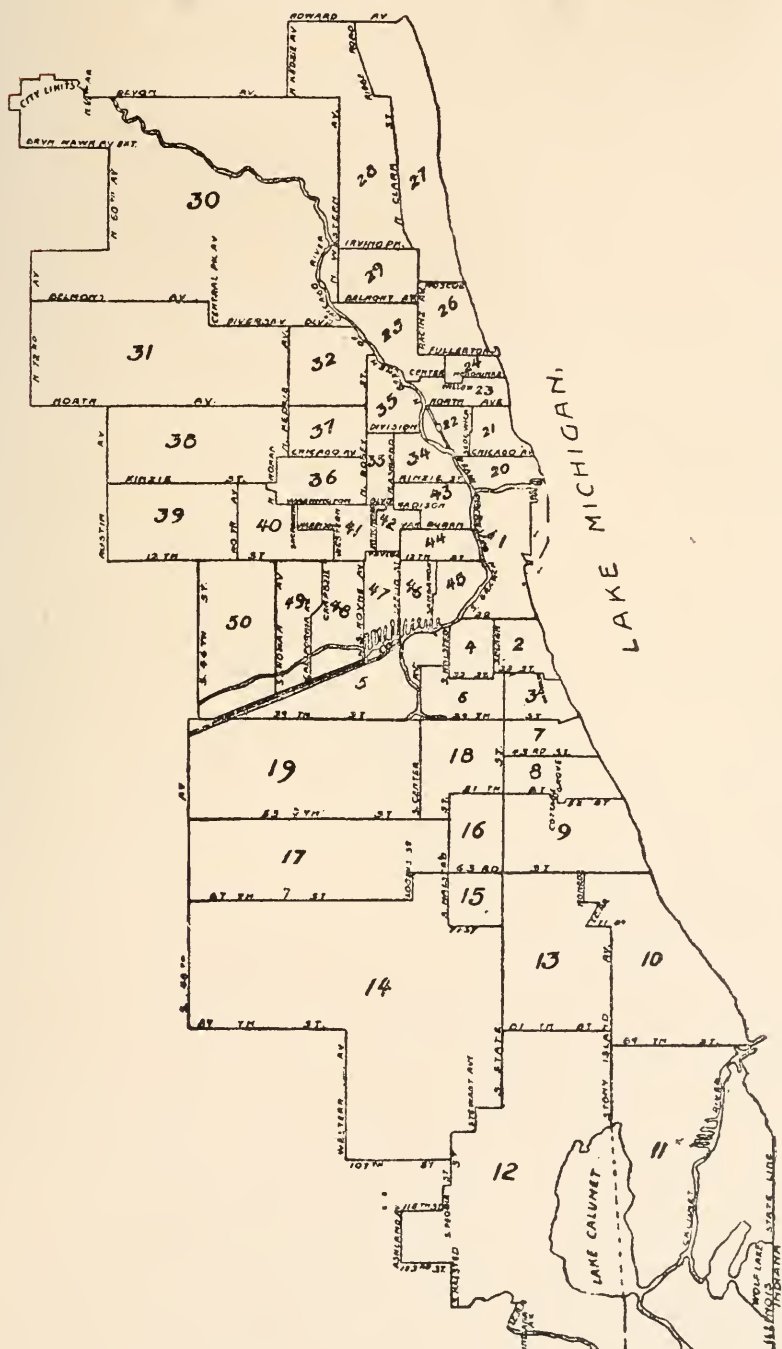
Miscellaneous appliances consuming less than 15 cubic feet per hour each	1/2 inch	20 feet
Gas cooking ranges	3/4 inch	30 feet
Ordinary coal ranges, equipped for the use of gas.....	3/4 inch	30 feet
Large heating stoves	3/4 inch	30 feet
Gas logs or other grate fires	3/4 inch	30 feet
Miscellaneous appliances consuming 15 to 40 cubic feet of gas per hour each	3/4 inch	30 feet
Miscellaneous appliances consuming 40 to 75 cubic feet of gas per hour	1 inch	60 feet
For special purposes not provided for above, apply to the company's inspector for information.		

SUMMARY.

1. All branches or cross lines of pipe from the main line must have a set not less than 4 inches dropped square, and must be well secured to joist by gas hooks or straps.
 2. All openings must be closed with iron caps, no split pipe or broken fittings repaired with cement or lead will be allowed.
 3. All drops on branch lines and openings for side brackets must be square bends; no nipples allowed.
 4. The risers in all buildings must be carried up an inside partition out of reach of frost and must be placed where the meter and stop cock can be readily got at. Vestibules not to be considered as inside partitions.
 5. To avoid trapping, gasfitters must grade all pipes to riser or drops.
 6. In no case will a meter be set where it is not easily accessible, or where it is exposed to frost and dampness, or liable to injury from any cause.
 7. All pipe for fuel must be run independent, and connected to light riser at meter end, with right and left, union, or running thread.
 8. Supply for gas engines must be separate, and an independent service will be required.
 9. Drops in churches, schools, public halls, stores, double parlors, large rooms, etc., must not be less than 1/2 inch.
 10. No riser in any building must be less than 3/4 inch and in stores must not be under deck of show windows, as meter will not be set there.
 11. The riser in any building must not be less than 20 inches from the floor for two to ten openings; 2 feet 6 inches for ten to thirty openings; 4 feet for thirty to sixty openings; 5 feet for sixty to one hundred openings; 6 feet for over one hundred openings.
- Where meters are to be set on wall, no riser must be higher than 9 feet from floor.
12. In all cases where extensions are made, care must be taken to break pipe where the rule for size can be maintained, and in no case shall extension be made from small pipes.
 13. In flat buildings meters should be set in basement or in room provided for meters; otherwise in premises where gas is consumed.
 14. All risers and building services must be brought to front of building and within 18 inches of wall or partition, and must not be less than 15 inches apart where risers are grouped.
 15. In all cases where building service is used, provide header with an opening for each riser; where risers are in groups, openings must not be less than 15 inches apart.
 16. Underground work by gasfitters between main and meter will not be allowed or accepted.
 17. To avoid complications, gasfitters should consult this Company before locating risers in corner buildings.
 18. In flat buildings where appliances are installed for the joint use of tenants, such as laundry stoves, driers, etc., run pipe from each meter to laundry and provide a header for a lock cock for each tenant. Fasten securely to each cock a metal tag with the flat number plainly marked thereon.
- In cases where one common riser is desired, locate header in laundry and provide lock cocks and tags as provided above.
19. All work must be proved with mercury gauge, not less than a 6-inch column of mercury being allowed.
 20. All pipe must be examined by the inspector of this company before being concealed, and twenty-four hours' notice must be given by gasfitters when any pipe is ready for inspection.
 21. If the rules concerning the size of pipes are not clearly understood in each case, or if unusual conditions are met with, which the rules do not cover, communicate with the company's inspector.
 22. It is the purpose of the company to strictly enforce the above rules, and no certificate of inspection will be given when they are not complied with.
 23. Architects, builders and owners of buildings are requested not to allow a bill for gasfitting unless accompanied by a certificate of inspection.

PROPOSED NEW CITY WARD MAP

As embodied in the new City Charter and to be voted on in September, 1907.



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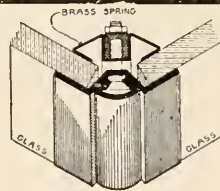
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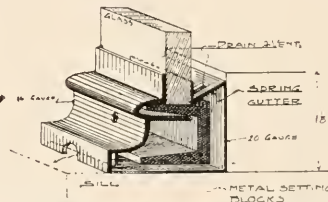
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STRENGTH OF MATERIALS.

STRESSES.

A 'stress' is a force which acts in the interior of a body and resists the external forces which tend to change its shape. Three kinds of simple stress are produced by forces which tend to change the shape of a body.

They are: Tensile, tending to pull apart, as in a rope; compressive, tending to push together, as in a column; shearing, tending to cut across, as in punching a plate.

The **ultimate strength** of a material under tension, compression, or shear, is the greatest unit-stress to which it can be subjected. This occurs at or shortly before rupture, and its value is very different for different materials; thus if a bar whose cross-section is A breaks under a tensile stress, P , the ultimate tensile strength of the material is $P \div A$.

When a small stress is applied to a body a small deformation is produced, and on the removal of the stress the body springs back to its original form. For small stress material, then may be regarded as perfectly elastic.

Under smaller stresses the deformations are approximately proportional to the forces, or stresses, which produce them, and also approximately proportional to the length of the bar or body.

When the stress is great enough a deformation is produced which is partly permanent, that is, the body does not spring back entirely to its original form on removal of the stress. This permanent part is termed a set. In such cases the deformations are not proportional to the stresses.

When the stress is greater still the deformation rapidly increases and the body finally ruptures.

A sudden stress, or shock, is more injurious than a steady stress or than a stress gradually applied.

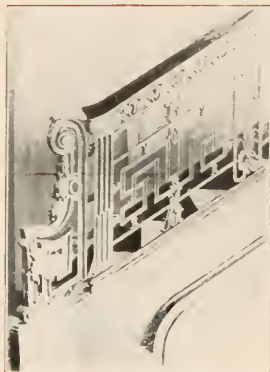
The **elastic limit** is that unit-stress at which the permanent set is first visible and within which the stress is directly proportional to the deformation. For stresses less than the elastic limit bodies are perfectly elastic, resuming their original form on removal of the stress.

The **working strength** of a material is that unit-stress to which it is, or is to be, subjected. For safety, this must not be greater than the elastic limit of the material used. It should be considerably less to allow for possible defects, usually taken at from one-third to two-thirds the average elastic limit.

Factor of safety for a body under stress or for a piece to be designed is the ratio of the ultimate strength to the working, or the proper allowable working, strength.

Fundamental principles of engineering design are stability and economy: First, the structure must safely withstand all the stresses which are to be applied to it; second, the structure must be built and maintained at the lowest possible cost.

The second of these fundamental principles requires that all parts of the structure should be of equal strength in proportion to the loads which they are required to carry.



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CHICAGO

BASE PLATES FOR COLUMNS.

By N. CLIFFORD RICKER, D. Arch.

Professor of Architecture in University of Illinois.

Written exclusively for The Handbook for Architects and Builders.

1. Explanations.

The following formulas and methods for designing base plates of columns are arranged in accordance with the Chicago Building Ordinances now in force.

The maximum pressure of the plate in lbs. per square inch upon the masonry beneath it, permitted by these ordinances, is as follows:

On concrete	173.61 lbs.
On dressed dimension stone	173.61 lbs.
On rough dimension stone	138.89 lbs.
On brickwork in best Portland cement ...	173.61 lbs.
On brickwork in ordinary cement	125.00 lbs.
On brickwork in lime.	90.28 lbs.

The resultant of all loads or pressures upon it should always pass through the centre of the base plate.

A steel plate is cut from a rolled plate, and it is therefore uniform in thickness.

A cast iron plate is reduced in thickness from exterior of column to edge of plate, which is usually three-eighths inch thick or more, according to dimensions of the plate.

For simplicity in form, the formulas for cast iron plates are based on the assumption of sharp outer edges of the plate. When the edges have the usual thickness, the resistance of the plate to fracture will be a little greater than if the edges are sharp, thus making the formulas entirely safe for use in practice. The line of fracture should be nearly straight for plates of good quality and uniform texture without flaws. Rolled steel plates do not break, but merely bend and may take a permanent set.

The maximum permissible fibre stresses prescribed by the Chicago ordinances are as follows:

Steel in tension or compression...	16,000 lbs./sq. in.
Cast iron in tension..	2,500 lbs./sq. in.
Cast iron in compression	10,000 lbs./sq. in.

2. Notation.

Let A = total required area of base plate in sq. ins.

Let P = total pressure of plate on masonry in lbs. (the load resting on plates).

Let p = maximum pressure of plate in lbs./sq. inch (which would be according to kind of masonry).

Let a = area in sq. inches of that part of plate that tends to break it along fracture line.

Let l = lever arm in inches of this area a = distance from fracture line to its center of gravity).

Let M = breaking moment in inch-lbs. acting at the fracture line.

Let R = resisting moment in inch-lbs. at the fracture line.

M necessarily equals R , unless fracture occurs.

Let f = maximum permissible fibre stress in lbs./sq. inch (which depends on kind of metal used).

Let I = moment of inertia of vertical section along fracture line.

Let c = distance in inches from neutral axis of vertical fracture section to its most distant fibre subject to tension.

We then have the following basic formulas.

$$A = \frac{P}{p} = \text{required area of plate in square ins.} \quad (1.)$$

$$M = a p l = \text{bending moment in inch-lbs.} \quad (2.)$$

$$R = \frac{f I}{c} = \text{resisting moment in inch-lbs.} \quad (3.)$$

$$M = R, \text{ from equality of moments at safe limit.} \quad (4.)$$

Hence the general equation will be:

$$M = R, \text{ or } a p l = \frac{f I}{c} \quad (5.)$$

A. PLAIN BASE PLATES WITHOUT RIBS.

3. Steel Square Plates.

Substituting the proper values for a , l , f , I , and c in the equations and reducing them to their simplest form:

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Fracture line 1—2, Fig. 1.

$$t = \frac{k}{40} \sqrt{\frac{3p}{10}} = \text{thickness in ins.} \quad (6.)$$

Fracture line 3—4, Fig. 1.

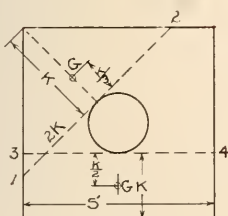


Fig. 1

$$t = \frac{k}{40} \sqrt{\frac{3p}{10}} = \text{thickness in ins.} \quad (7.)$$

Apply formulas 6 and 7, and make the thickness equal to the larger value of t .

4. Steel Round Plates.

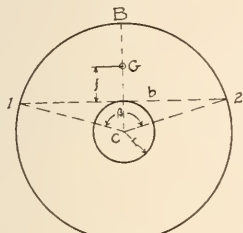


Fig. 2

Join ends of fracture line 1—2, Fig. 2, with the centre C, and measure the angle β at centre between C—1 and C—2.

$$\text{Then: } \frac{A\beta^\circ}{360^\circ} = \text{area in sq. ins. of the sector 1—B—2—C.} \quad (8.)$$

A here = area of circle in sq. ins.

$$\frac{br}{2} = \text{area of triangle 1—C—2.} \quad (9.)$$

Then (area of sector)—(area of triangle) = area a of segment 1—B—2. (10.)

Also: $\frac{b^3}{12a} = \text{distance in ins. from centre C to centre of gravity of segment.} \quad (11.)$

$$\text{Then } l = \frac{b^3}{12a} - r. \quad (12.)$$

Substituting values and reducing equation of moments:—

$$t = \frac{1}{40} \sqrt{\frac{3ap}{5b}} = \text{thickness in ins. of plate in ins.} \quad (13.)$$

5. Steel Octagonal Plate.

The area a can be easily found by dividing that portion of the plate into triangles and computing their areas. Lo-

cate centre of gravity of area a by any graphical method, and measure b and l in inches.

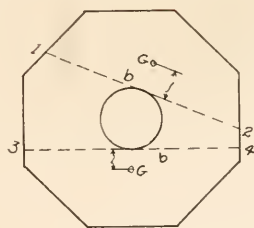


Fig. 3.

Fracture line 1—2, Fig. 3.

$$t = \frac{1}{40} \sqrt{\frac{3ap}{5b}} = \text{thickness of plate in ins.} \quad (14.)$$

Fracture line 3—4, Fig. 3.

Apply formula 14 with the proper values of b and l. Take the larger value found for the thickness t.

6. Cast Iron Square Plate.

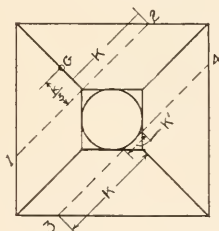


Fig. 4.

Fracture line 1—2, Fig. 4.

$$t = \frac{k}{50} \sqrt{2p} = \text{thickness of plate in ins.} \quad (15.)$$

Fracture line 3—4, Fig. 4.

$$t = \frac{1}{50} \sqrt{\frac{2p(k + \frac{k'}{2})^3}{k + k'}} = \text{thickness of plate in ins.} \quad (16.)$$

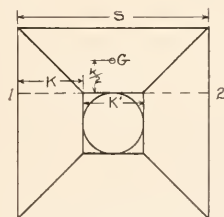


Fig. 5.

Fracture line 1—2, Fig. 5.

$$t = \frac{k}{50} \sqrt{\frac{3p(2k + k')}{k + k'}} = \text{thickness of plate in ins.} \quad (17.)$$

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Take the larger value of t found by the three formulas as the thickness of the plate.

7. Cast Iron Round Plate.

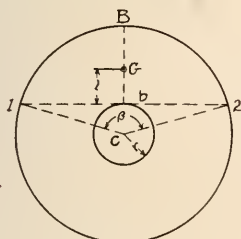


Fig. 6.

Fracture line 1—2, Fig. 6.

Find area a of segment 1—B—2 and its lever arm l as described in Sect. 4.

The vertical fracture section 1—2 of this plate is actually a very flat hyperbola, but for simplicity, a parabola of equal span and rise is substituted without serious error.

Substituting the proper values in equation of moments and reducing:—

$$t = \sqrt{\frac{7 a p l}{2000 b}} = \text{thickness of plate in ins.} \quad (18.)$$

8. Cast Iron Octagonal Plate.

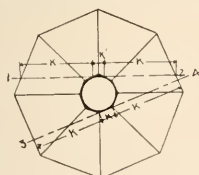


Fig. 7

Fracture line 1—2, Fig. 7.

The form of fracture section is much more complex in this case, but the thickness of the plate may be found by a tentative method.

Find values of a and l graphically; assume thickness t and draw fracture section; determine values of I and c for this section graphically; compute value of f

by equation of moments, $a p l = \frac{f I}{c}$; re-

peat with other values of t , if necessary, until $f = 2,500$, when the corresponding value of t is the required thickness of the plate in ins.

Or, apply the following empirical approximate formula deduced by Mr. C. R. Dick in 1907:

$$t = \frac{1}{50} \sqrt{\frac{6 a p l}{k + k'}} = \text{thickness of plate in ins.} \quad (19.)$$

9. Tests of Plain Base Plates.

During the year 1906-7, Mr. C. R. Dick, a senior student in architectural engineering in this University, designed a series of steel and of cast iron plain base plates of square, octagonal, and circular form, using the preceding formulas. He afterwards tested these plates with the following results:

Steel plates did not perceptibly bend under the maximum safe pressures p , but took a permanent set under much greater pressures, and did not break.

Cast iron plates were broken under pressures from 7 to 13 times the safe pressure p for which they were designed. Flaws were found in the plates showing least strength.

Therefore the preceding formulas are entirely safe for practical use.

With careful inspection, this would also be true if the safe fiber stress were increased from 2,500 lbs./sq. in. to 3,000 lbs./sq. in., as permitted in many large cities.

B. RIBBED CAST IRON BASE PLATES.

10. Explanations.

Very little attention appears to have been devoted to the theory of design or to actual tests of such plates, although they are in very common use.

E. Claussen (Statik und Festigkeitslehre, pp. 180 to 184) states that each rib supports independently its proportionate portion of the pressure area of the plate like an inverted bracket, and that the corresponding bending moment is opposed by the resisting moment of the T-shaped cross section of the rib and a portion of the plate, tangent to the hub at the root of the rib. On this theory is based the first method of design given here.

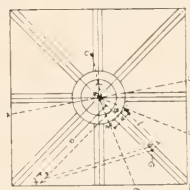


Fig. 8

11. First Method of Design.

Assume a square plate, for example, as in Fig. 8, with a central hollow hub and eight equidistant ribs. Divide the bottom plate into eight portions by radial lines bisecting the angles between the ribs. Draw line 1—2 tangent to the hub and perpendicular to rib C—A. Then 1—5—A—6—2 is the pressure area supported by rib C—A, and 1—2 is its fracture line.

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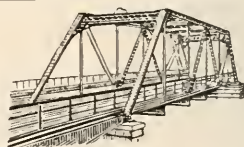
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The thickness of the bottom plate is first found by the following formula:

$$t = \frac{m}{50} \sqrt{\frac{p}{2}} \quad \text{thickness of bottom plate in inches.} \quad (20.)$$

Here, m = greatest clear distance in inches between two adjacent ribs.

Compute area of figure C—5—A—6 and locate its center of gravity at D.

Compute area of triangle C—1—2 and locate its center of gravity at B.

Then the pressure area a = difference of the two preceding areas.

Through B, draw B—E in any convenient direction and numerically equal to a ; join E—D; produce B—E, making E—F = a' (at same scale as a) the area of the triangle just found; draw F—G parallel to E—D, intersecting C—A in G, which will be the center of pressure of the pressure area a . Then l is easily measured, and:

$M = a p l$ = bending moment in in lbs. acting at fracture line 1—2. (21.)

Assume height and thickness of the rib and draw the fracture section, as in Fig. 9.

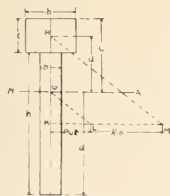


Fig. 9.

Locate center of gravity H of the portion of the plate, and that of rib at K. Through K, draw K—M in any convenient direction, making K—L numerically equal to area $b \times t$ of section of plate and L—M numerically equal (at same scale as plate area) to area $b' \times h$ of rib. Join M—H and draw L—G parallel thereto, cutting H—K in G, which is the center of gravity of the fracture section. Draw the horizontal neutral-axis N—A through G.

Then c = distance in ins. from G to top of section.

$$I = \frac{b t^3}{12} + b t d^2 + \frac{b' h^3}{12} + b' h d^2, \quad (22.)$$

Resisting moment R of fracture section in in-lbs. is:

$$R = \frac{f I}{c} = \frac{2500 I}{c} \quad (23.)$$

Try different heights of rib until one is found for which R equals, or is a little larger than M, and this will be the required height of rib.

It is evident that this method of design provides some excess of strength in the plate, since the resistance of the bottom plate to rupture along the radial lines C—5, C—6, etc., is not taken into account.

12. Applications to Different Forms of Plates.

To avoid the necessity of reference to other books, the methods of locating the center of gravity of a sector of the bottom plate are here given.

a. Square Plate. Fig. 10.

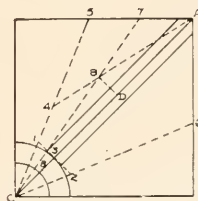


Fig. 10.

Bisect 5—A by line C—7; also C—5 by line A—4; through their intersection draw 8—D perpendicular to C—A, and D is the center of gravity of the area C—5—A—6.

b. Round Plate.

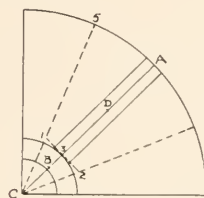


Fig. 11.

For 4 ribs, make $C—D = .600 \times C—A$.
For 6 ribs, make $C—D = .637 \times C—A$.
For 8 ribs, make $C—D = .650 \times C—A$.

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c. Octagonal Plate.

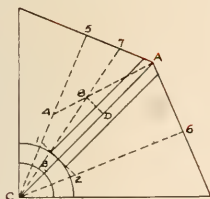


Fig. 12.

Apply the same method as for a square plate.

12. Second Method of Design.

Assume that the base plate will break along a diameter intersecting the hub, but not the ribs, as along the fracture line 3—4 in Fig. 8.

The pressure area a is here a trapezoid, whose center of gravity G is easily located, then obtaining its lever arm l .

Then its moment $= M = a p l$, as before.

Assume the height h of hub and ribs and draw the vertical fracture section of the plate along line 3—4, as in Fig. 13.

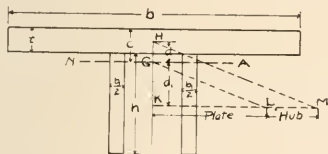


Fig. 13.

Locate H , the center of gravity of section of plate, and K , center of gravity of section of hub, then finding G as before indicated, which will be the center of gravity of the fracture section. Draw through G the horizontal neutral axis $N—A$ of the section.

Compute moment of inertia I of the section by formula 22 in Sec. 11, and measure distance c in ins.

$$\text{Then resistance moment } R = \frac{2500 I}{c} \quad (24.)$$

Try different values of h , the height of the hub and ribs, until R equals or slightly exceeds M , when the corresponding value of h will be the height required.

This method of design is evidently safe, and it must also be somewhat more economical than the first method, because the resistance of the bottom plate to fracture along radial lines is here taken into account.

During the year 1906-7, Mr. C. E. Noerenberg, a senior student in architectural engineering, designed a series of ribbed cast iron base plates by the first method, comprising ten different types, square, circular, and octagonal, with four or eight ribs each, arranged in different ways. These plates were set on an elastic cushion and tested to destruction with the following results, as summarized by him in an excellent thesis:

Factor of safety varied from 16 to 31, according to form of plate, number and arrangement of ribs, showing that the first method of design is absolutely safe.

Eight ribs are preferable to four, and it is better for ribs to extend to angles than to centers of sides of the plate.

Most of the plates broke along a diameter through, or tangent to the hub, into two or more pieces. Some broke radially in several pieces.

Cast iron ribbed base plates are entirely safe, and they are probably more economical and preferable to those built up of steel plates and shapes.

The second method of design is likewise safe, and it appears to accord more nearly with the actual mode of fracture of the plates, and is therefore to be preferred for practical use. Either one is much superior to the empirical methods and rules too frequently employed.

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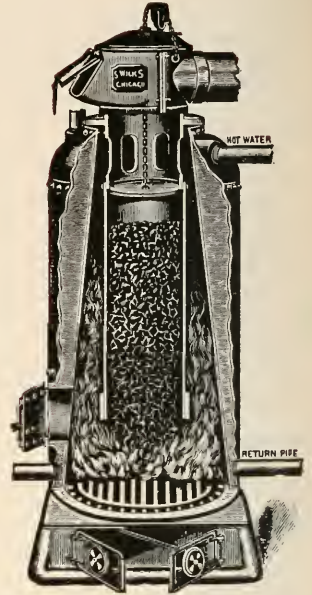
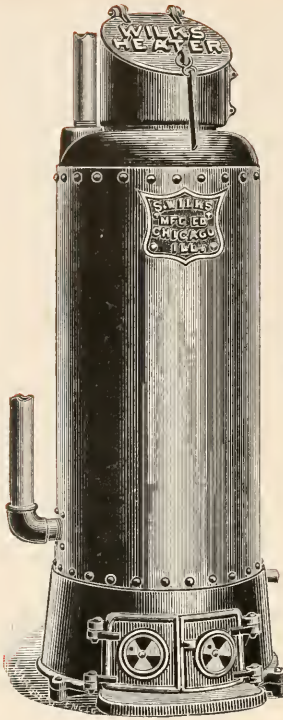
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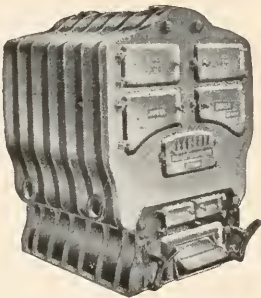
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The overhead or Mills system was patented by Mr. Mills of Boston, but in an address by him to the master steam fitters, at their convention in New York in 1890, was released to the use of the public. It consisted of a main riser to the top of the building, laterals above the highest radiators distributing the steam to the radiator risers with corresponding branches either on basement ceiling or below the basement floor, branches for the radiators being taken out from the riser below the floor line at the radiator. This system is very useful in large buildings or buildings having very little height in basement for suitable pitch of the main pipes. The two-pipe system is one that has been adopted for many years, though not now in general use. It consisted of a separate main at basement ceiling with corresponding return at or below basement floor, each radiator equipped with two valves, one for supply and one for return, the supply coming from main at basement ceiling and the return entering the main return at or below the basement floor. Into this return, also, at frequent intervals, is connected a branch from the main steam pipe, which acts as a bleeder or drip for conducting the water from the steam main back to the boiler. In this system the main steam and main return pipes, also the risers to and from the radiators may be of smaller size than are used in the single pipe or single valve system. The double pipe system has one advantage over the last mentioned, as by its use the valves may be partially opened without causing the hammering noise noticeable in the others, unless valves are either entirely closed or opened full. Its expense and the considerable cutting necessary for its installation are against it, though it must still be used where indirect radiation is wanted. The one-pipe system is nearly if not quite obsolete. It consisted of one pipe run from top of boiler to the radiator, the boiler being the low point, so that the steam and water of condensation traveled in opposite directions in the same pipe, which of necessity was of large diameter comparatively. This system was used very extensively in connection with the old sheet iron radiator.

The single valve system is the one most in use at the present time. Having steadily gained favor since about 1880, it is now almost universally adopted. In construction it is the reverse of the single pipe system (though often misnamed the single pipe system). The high point in the main pipe is at the boiler. The main pipe may be what is known as a continuous circuit, in which case it starts high at boiler, gradually falling as it passes around the basement back to the boiler, where it abruptly drops, entering the boiler at the bottom. The water and steam in the main travels in the same direction. The laterals or branches to the radiators are taken from the top of the main and the pitch is from the radiator to the main, the water and the steam, as in the single pipe system, thus traveling in reverse directions only in the branches to the radiators. The philosophy of the single valve system lies in

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the fact that the transverse area of its one pipe and one valve equal nearly the transverse area of the two pipes and two valves of the two pipe system. As before stated, it is very necessary that the valves on the radiators of this system should be operated intelligently, as a valve opened partially, while permitting the steam to enter, will not permit the water (the result of the condensation of the steam) to return to the boiler. The least that can happen under these conditions is a very considerable noise in the radiator when the valve is opened until the water leaves the radiator. (It is the opinion of the writer that more than one-half the damage of cracked boiler sections can be laid to faulty manipulation of the radiator valve.)

Air valves upon radiators are important and preferably should be automatic, though whether automatic or not is a matter for the consideration of the user. The fact that the air must be expelled before the steam can enter the radiator to be condensed and yield up its heat necessitates their use. If automatic they should be non-adjustable and tinkering proof. A valve worked by air expansion is ideal for this purpose.

The thorough cleaning of the steam heating apparatus before permanent air valves are placed cannot be too greatly emphasized. Oil and sand cause more faulty working apparatus than any other cause, in apparatus that is otherwise well constructed. As a matter of fact apparatus on the verge of condemnation for general inefficiency has, in the experience of the writer, been converted into a first-class apparatus simply by a thorough cleaning and the use of chemicals to precipitate the oil, so as to facilitate its removal. To account for the presence of oil in an apparatus it is only necessary to call attention to the fact that beside the oil used in construction, all the cores over which the iron in the radiator sections, the boiler castings, and even the fittings is poured, are composed of oil and sand, part of which adhere to the inside of the castings. The steam condensing on these surfaces eventually carries this oil back to the boiler, where it lies like a blanket on top of the water. It may be removed by frequent blowing out of the boiler or a few cents' worth of chemical put into the boiler and circulated by steaming a few days, will permit of its being thoroughly cleansed by blowing it off once. This blanket of oil prevents the steam from passing through and the pressure frequently forces the water from the boiler up through the return pipes, and aside from the annoyance may easily become a dangerous condition. Why a condition so common has received so little attention is beyond finding out, and as it occurs in all steam heating apparatus this cleaning should be written in all specifications and insisted upon.

As to the size of mains, Professor Carpenter says: "The area of the main pipe must in every case be equivalent in carrying capacity to that of all the branches taken off; it consequently may be reduced as the distance from the boiler becomes greater or as more branches are supplied. It will in general be found, except when large pipes are used, less expensive to run the main full size rather than to use reducing fittings."

Find the area by multiplying the amount of radiating surface. If 1,400 feet or less, by .009; if 1,600 feet or more, by .008, and then use pipe with area nearest to that so found; thus radiating surface pipe will supply:

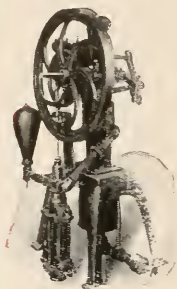
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	Work	Two Pipe Work
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250 square feet	2 inch	1½×1¼ inch
400 square feet	2½ inch	2 ×1½ inch
650 square feet	3 inch	2½×2 inch
900 square feet	3½ inch	3 ×2½ inch
1250 square feet	4 inch	3½×3 inch
1600 square feet	4½ inch	4 ×3½ inch
2050 square feet	5 inch	4½×4 inch
2500 square feet	6 inch	5 ×4½ inch
3600 square feet	7 inch	6 ×5 inch
5000 square feet	8 inch	7 ×6 inch
6500 square feet	9 inch	8 ×6 inch
8100 square feet	10 inch	9 ×6 inch

HOT WATER HEATING.

Heating by water or the vapor of water, i. e., steam, is accomplished in many ways, and has been utilized for the comfort of humanity for many years, and of late years is used exclusively for large buildings and almost universally for the modern homes and apartment buildings. The use of hot water for heating purposes is interwoven

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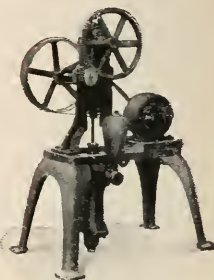
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with the history of Rome, though it has become a commercial proposition within the last thirty years, and to-day in the United States there are millions of dollars invested in factories and machinery for the production of apparatus for this purpose. When what may be called the modern hot water heating apparatus was introduced in 1875, it was considered good practice to run a separate pipe from the top of the boiler to each radiator, with a corresponding return pipe from each radiator to the bottom of the boiler. Where this system was put in with pipes properly proportioned relative to their length the circulation was perfect. However, the cost of such an apparatus was very high and led to the introduction of what is known as the two-pipe system, which is still highly recommended by some of the best heating engineers. About 1890 what is known as the one-pipe system was introduced, and as it could be installed at a much lower cost it has gained popularity and is used extensively. The overhead system, otherwise known as the Perkins system (though in the opinion of the writer should be credited to Mr. Mills of Boston), probably antedates the systems referred to above, but is used oftener under conditions that will not permit the use of the other systems mentioned, rather than from choice. Another system is referred to only that its use may be avoided. This system is known as the pressure system, and as its pressure is obtained by what is known as safety valves set so that a given pressure may be carried before they will open, it is considered dangerous and is not recommended by the best engineers. As a matter of fact, few, if any, accidents have ever happened to a hot water heating apparatus that have not been caused by undue pressure due to freezing of the open vent pipe or the safety valve failing to operate. The pressure system, owing to the fact that it may be installed cheaply, has a few advocates. With this system smaller radiators may be used, as under pressure a greater range of temperatures may be had. The advantages of the hot water apparatus are, however, practically all lost, as the friction incident to the circulation of the water through small pipes does away entirely with economy of operation, which, after all, is of much more consequence than low first cost.

Hot water heating apparatus cannot be too generous in its proportions, as low temperatures depend upon the size of the radiators, and slow combustion depends upon the size of the boiler. Slow combustion means economy. Comparing size of radiators with those of the steam apparatus, they should be at least as 8 is to 5, that is to say, that a radiator for hot water for a given space should be three-eighths larger than one for steam to heat the same space. It should be understood, also, that all hot water apparatus is always under pressure to the extent of the height of the column of water, one pound pressure for every 27 inches of height of the column.

In the open tank system the basement piping consists of supply and return mains of the same size running parallel or with return directly under the flow pipes and pitching upward from the boiler. What is known as the trunk system consists of one supply and one return main of equal size. These are run in pairs and each radiator has supply and return of same size.

Each radiator has a valve and union ell at the opposite end of it. If one main only is used the radiators on first floor should be supplied direct and should have larger connections. Radiators on the second and upper floors can be supplied from one branch. The ends of supply and return should be larger than the supply riser.

To find the size of mains multiply the radiating surface: When 1,800 feet and less, by .011; when 2,000 feet and over, by .009.

		Direct Radiation Will Supply,	Indirect Radiation Will Supply,
Size of Main.	Area.	Feet.	Feet.
1½ inches	2.03	200	135
2 inches	3.35	325	200
2½ inches	4.78	450	300
3 inches	7.38	700	450
3½ inches	9.82	900	600
4 inches	12.73	1200	800
4½ inches	15.93	1500	1000
5 inches	19.99	2000	1200
6 inches	28.88	3000	2000
7 inches	38.73	4200	2800
8 inches	50.03	5600	3600
9 inches	63.63	7000	4600
10 inches	78.83	8500	5600

~~~~~

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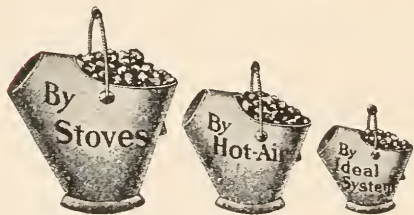
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In the case of water being used, an expansion tank is necessary, for as the temperature of water rises until at the boiling point it is 5 per cent. greater than at 40 degrees the increase must be provided for, so that when cooled the system will still be full of water. It should be placed at a point above the highest radiator, the supply and return to it being connected to the supply and return of the nearest radiator, at a point below the radiator connection. No valves should be placed at any point that can possibly close the connection between the boiler and the tank.

To find the size of tank in gallons required, multiply the square feet of surface in the radiators, if the amount is less than 1,000 square feet, by .03; between 1,000 and 2,000 square feet, by .025; over 3,000 square feet, by .02.

An altitude gauge placed near the boiler will save watching the expansion tank. Fill the expansion tank to a point half way up the glass, and set the red hand of the gauge to indicate that point, and the movement of the movable hand will indicate the relative position of the water in the tank.

In the matter of radiation, the surface required is most important. In all cases the radiators should be placed as near the windows or outside exposures as possible. Low and curved window radiators add to the cost. Conditions vary considerably and must enter into the calculations of amount of radiation necessary. Glass exposure, wall expose, cubic contents, location, exposure and construction of building must all be taken into account.

Ascertain the dimensions of room, the number of square feet of glass surface in windows and outside doors, figuring these doors as if glass, and measuring the entire opening of windows and door-frames. Ascertain the square feet of exposed wall surface, and deduct the glass surface as obtained above, and this will be the net amount of wall exposure. Reduce the wall surface to the equivalent of glass surface by dividing the net amount of wall exposure by 10 if the wall is from 8 to 10 inches thick, by 15 if from 12 to 26 inches thick, and by 20 if the wall is 26 to 38 inches thick. This result, added to the glass exposure, gives the glass equivalent of the glass and wall exposure. Multiply this glass equivalent by 75 (the cubic feet of air that each square foot of glass will cool per hour), and the product is the cubic feet of air to be heated to overcome the cooling effect of the glass and wall exposure. Now add to this the cubic contents of the room, and we have the total quantity of air to be heated.

It is customary to guarantee a temperature of 70 degrees in zero weather. To arrive at the amount of radiation under this guarantee multiply the quantity of air to be heated by the decimals given below, and the product will give number of feet required.

In localities where the temperature falls below zero, add to the amount of radiation obtained 1 per cent. for every degree below zero.

For Hot Water.—For temperature of water in radiators, 160 degrees, multiply by .0092; water in radiators, 170 degrees, multiply by .0081; water in radiators, 180 degrees, multiply by .0072.

For water use the multiple .0092; for if water is 175 degrees in flow and 145 degrees in return, the average is 160 degrees in radiation.

This is based upon using direct radiation, and provides for one change per hour. For more frequent changes increase the cubic contents by as many times as it is desired to change the air, the multipliers remain the same.

Direct radiation is surrounded by warm air, but cold air comes in contact more or less with their surfaces, in direct-indirect and indirect systems, so that for direct-indirect add 25 per cent. and for indirect 50 per cent.

EXAMPLE FOR DIRECT RADIATION.

Room— 16 feet wide, 20 feet long, 10 feet high.
 4 windows, 3 feet wide, 5 feet high.
 2 sides of room exposed to 0° weather.
 10 inches thickness of wall.
 $16 \times 20 \times 10 = 3200$ cubic feet of air in room.
 $3 \times 5 \times 4 = 60$ square feet of glass in windows.
 $16 + 20 \times 10 = 360$ square feet of wall surface exposed, including glass.
 $360 - 60$ (glass) = 300 square feet actual amount of exposed wall surface.
 $300 \div 10 = 30$ — glass equivalent in wall exposure.
 $30 + 60 \times 75 = 6750$ — air in cubic feet cooled by windows and walls.
 $3200 + 6750 = 9950$ — total in cubic feet of air to be heated.
 $9950 \times .0055$ (multiplier for steam) = 54.72 radiation in square feet required to heat room.

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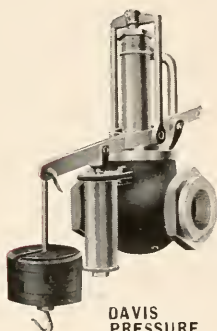
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Indirect radiation is adopted where a large amount of ventilation is desired. It is particularly necessary in schools, hospitals and churches, and in dwellings one or two indirect stacks are desirable. This method of heating is decidedly more expensive than all direct radiation, and consumes more coal. It is frequently used in combination with direct radiation, and in this case ventilating flues must be provided. Either fireplaces or special flues from each apartment so warmed to the open air, and these flues (as well as from those conducting heat) must be placed in inside walls or partitions.

In installing this system the heating stacks are placed in the basement, connected to main supply and return pipes and encased with either galvanized iron, or narrow ceiling lined with tin. The cold air is introduced through air ducts from the outside, and after being warmed by contact with the indirect heating surfaces, is introduced into the rooms through tin flues and registers.

SIZES FOR CHIMNEYS.

A very essential adjunct to the working of a plant is the chimney flue, and the form of the flue has much to do with its effectiveness; thus as gases ascend in a spiral motion a round flue is the best, and a square one is better than one of rectangular shape. If of brick it should be evenly plastered. The flue should extend below the smoke pipe connection only a short distance to permit the removal of soot, if continued far below it will form an air pocket and cause down currents.

Square Feet of Direct		Square Feet of Direct	
Steam Radiation.	Horse Power.	Size of Chimney.	Water Radiation.
250	2.5	8 x 8	400
500	5.0	8 x 12	850
800	8.0	12 x 12	1350
1400	14.0	12 x 16	2400
2200	22.0	16 x 16	3700
3500	35.0	16 x 20	5900
5500	55.0	20 x 20	9300
8000	80.0	20 x 20	13000

The ventilation of rooms is a very important factor. A certain amount of space is necessary to provide change of air, the circulation of which is of more importance than is generally attached to it, in this respect the indirect system of heating is advocated.

In theaters, churches, etc., provision should be made to admit from 400 to 1,500 cubic feet of air per hour for each person. In school rooms children should be provided with 600 cubic feet, and grown persons 1,200 cubic feet of air per hour. The Massachusetts law requires 30 cubic feet of fresh air per minute for each pupil, or 1,800 cubic feet per hour. This requirement represents the most advanced American practice. From 2,000 to 3,000 cubic feet of air per hour per occupant is required in hospitals and workshops. Each cubic foot of gas burned for illumination will consume from 8 to 12 cubic feet of air per hour.

The number of respirations men take on an average is 20 per minute, the volume of the air inhaled at each inspiration is equal to 40 cubic inches. The atmosphere of a lighted room containing several persons is vitiated to such an extent as to require a supply of fresh air equal to 4 cubic feet per minute for each.

Main supply pipes should run from top of boiler with a rising inclination of about $\frac{1}{4}$ inch to 10 ft.

A cubic inch of water at 212° becomes very nearly a cubic foot of steam at the same temperature, expanding as it does into 1,696 times its volume.

Radiation for steam weighs about 7 lbs. per sq. ft.; for hot water, about 7½ lbs.

The circulation of the air is of more importance than is generally attached to it, and the indirect system by means of which fresh heated air is introduced is to be advocated. Fire places are of great use for purposes of ventilation.

FORMULA FOR CALCULATING RADIATION.

The following is successfully used by a prominent member of the C. A. B. A.:

First ascertain the cubical contents, glass surface (which includes the surface of all exterior doors and windows), take into account whether N., S., E. or W.

Let "I" be the inside temperature desired, say 70° Fahrenheit, "E" the coldest exterior temperature, "V" volume of room in cubic feet, "W" exterior wall surface of room in square feet, "G" exterior windows and doors in square feet, "R" standard amount of surface radiation in square feet, "F" factor depending upon method of heating or particular story heated. When hot water overhead system is used: 4 story building,

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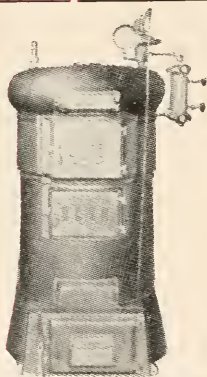
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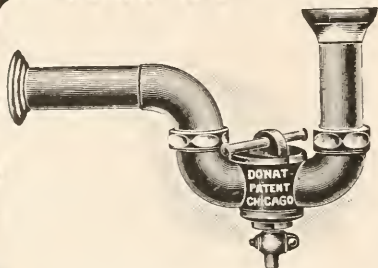
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adopt 1.3 for first story, 1.2 for second, .90 for third and .60 for fourth. In 3 story buildings, 1.25 for first, 1 for second and .75 for third. For 2 story, 1.2 for first and .8 for second.

When the steam heating method is used, "F" becomes a constant equal to .8. "J" factor depending upon exposure equal to 1.4 for N., W. and N. W. exposures, equal to 1.2 for N. E. and S. W. exposures, equal to 1 for E., S. and S. E. exposures, and also for small interior courts and places well protected from north and west winds. For bathrooms where a higher temperature is usually desired J is often made 2 instead of the usual rule. Kitchens where coal ranges are used, "J" is often made as low as .5, usually .75; but where there are no coal ranges "J" should be made 1-10 less than the factor obtained for the above.

$$\left\{ \frac{V}{400} + \frac{W}{10} + \frac{G}{2} \right\} \left\{ \frac{I-E}{I} \right\}^9 = R. \quad Q \text{ equals the desired square feet direct radiation}$$

surface for a room. $Q = R F J$. "E" is usually taken as 10° higher than the minimum

recorded temperature of the locality. "I" is taken as 70° , therefore the quantity $\left\{ \frac{I-E}{I} \right\}^9$

becomes a constant for any given locality, for Chicago where the minimum temperature is minus 20° the quantity is taken at 1.03.

The diameter of all supplies in inches should not vary materially from the square root of the amount of radiation to be supplied by the pipe, divided by 100. Reduced to inches, this rule is equally applicable to the supply of a single radiator or the supply of an entire system. Good judgment must go with the use of all empirical formula, especially in the use of the factor "J," which might be called the judgment factor. Location of surrounding buildings, trees, open space, etc., should be considered in the selection of a value for "J."

AUTOMATIC HEAT REGULATION.

Automatic heat regulation is now recognized as a very necessary item in the equipment of modern buildings, its use being justified on the grounds of fuel economy, comfort, and, in residence work, particularly, preservation of interior finish.

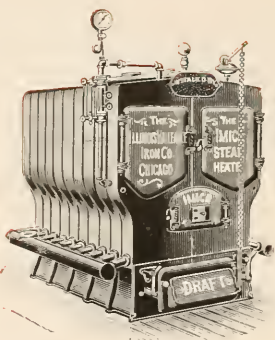
Its application naturally depends upon the character of the heating apparatus, it being essential in all cases that each heated apartment be supplied with at least one of the temperature controlling instruments called "thermostats," this "thermostat" regulating automatically the sources of heat supply for the apartment in which it is placed.

If the system of heating be direct radiation, the control of the radiators is accomplished by means of pneumatic diaphragm valves taking the place of the ordinary hand valves, these pneumatic valves being connected with the "thermostat." If indirect heat is used, the passage of the warm air through the heat flues is usually controlled by "mixing dampers," so arranged as to automatically mix hot and cold air in the proper proportions before it reaches the apartment, these mixing dampers being under the control of the "thermostats."

The heat regulation systems of recognized standing are generally operated by compressed air supplied by a suitable compressor in the basement, and distributed throughout the building by a system of galvanized iron and lead piping. The manufacturers of these systems invariably install the apparatus themselves, either as principal or sub-contractors, but in all cases executing to the owner a guarantee covering the operation and care of the system. The evidence seems to show that a saving of from 15 to 25 per cent in fuel consumption is accomplished in those buildings which are equipped with automatic heat regulation. This is a sufficiently large return upon the cost of the apparatus to justify its use in the majority of buildings. In residences, schools, etc., its use is imperative for hygienic reasons as well.

Specifications for temperature regulation should cover the system of piping to be installed minutely, as on the method of piping, and the size and kind of pipe used, depends, in a great measure, the success and durability of the system.

In connection with automatic control of temperature, there is also the control of the humidity of buildings, produced by artificial means. The question of humidity is a matter of great importance in buildings, and it is only since the invention of temperature regulation and the control of humidity that the device for producing humidity can be successfully installed.

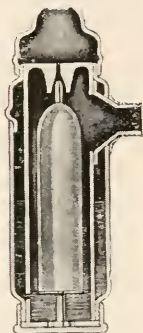


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RULES FOR PROPORTIONING RADIATION AND MAINS.

Professor R. C. Carpenter, of Cornell University, submits the following rule for determining the size Radiator needed for a given room:

Rule: Add the area of the glass surface in the room to one-quarter of the exposed wall surface and to this add from $1/55$ to $3/55$ of the cubical contents ($1/55$ for rooms on upper floor, $2/55$ for rooms on first floor and $3/55$ for large halls); then for steam multiply by .25 and for hot water .40.

Example: A room $20 \times 12 \times 10$ feet with glass exposure of 48 feet, $\frac{1}{4}$ of wall exposure (two sides exposed) 320 feet $= 80$, $1/55$ of $2,400 = 44$.

$$48 + 80 + 44 = 172 \times .25 = 43 \text{ feet.}$$

If you add $2/55$ the surface would be 54 feet.

If you add $3/55$ the surface would be 65 feet.

A rule which has been adopted by many leading heating engineers and which can be followed with confidence in proportioning radiation, is as follows:

Allow 1 sq. ft. of radiation for 2 sq. ft. of glass.

Allow 1 sq. ft. of radiation for 20 sq. ft. of exposed wall.

Allow 1 sq. ft. of radiation for 200 cu. ft. of contents.

The sum of these amounts would represent the number of feet of heating surface it would require for steam. For hot water add 70%. This is based on a temperature of 70° with the outside temperature 10° below zero.

Another rule adopted by many heating engineers is to add to the glass surface 10% of the wall surface and multiply this sum by 75 and, to this amount add the cubical contents of the room. For hot water radiation multiply this sum by .0092, for steam by .0055.

This is based on a temperature of 70° with the temperature outside at zero. In localities where the temperature falls below zero, add to the amount of radiation obtained, 1% for every degree below zero.

TABLE OF EQUIVALENT TEMPERATURE FOR TESTING A HEATING PLANT AT DIFFERENT OUTSIDE TEMPERATURES.

For the purpose of indicating the efficiency of the apparatus for any specified condition, Prof. Carpenter gives the following table, which has been generally accepted as the standard test.

For steam, the Radiator temperature in all cases is assumed to be that due to a pressure of 3 lbs. at the boiler, or about 220° Fahr.

For water, the Radiator temperature is assumed in all cases to be at an average or 160° Fahr.

For a plant proportioned sufficiently to maintain a temperature of 70° when the outside temperature is at zero.

Temperature of Outside Air	Room should be raised to	Temperature of Outside air	Room should be raised to
10	64.7	50	98.7
0	70.0	60	104.7
10	75.1	70	110.5
20	81.0	80	117.1
30	86.5	90	123.5
40	93.1	100	130.3

EXPANSION AND CONTRACTION.

Scarcely anything can withstand the expansion of iron. It expands from 32° to 212° , about $1/900$ of its length, which in 100 feet equals $1\frac{1}{3}$ inches. The expanding power of a 2-inch pipe when heated to a temperature of 100 pounds steam, or to 338° exerts a force sufficient to move 25 tons.

Cast iron expands $1/162000$ of its length for each degree Fahr. it is subjected to within ordinary limits while in its solid state.

Wrought iron expands $1/150000$ of its length for each degree Fahr. To find the expansion of a line of pipe, multiply its length in inches by the number of degrees of temperature applied and divide the product by 150,000 for required expansion in inches; thus $100' \times 12" = 1200 \times 338^\circ = 405600 \div 150000 = 2.7$ inches.

Special attention, then, must be given to the expansion and contraction of pipes and allowance made for it. Pipes and branches must be unconfined, especially in the direction of their length.

Expansion joints should not be used if the expansion can be compensated for in any other way.

SPACE OCCUPIED BY FUEL.

Coals of the same size coming from different mines vary in density, but the space given below is an average for best fuels:

Stove Anthracite	33	cubic feet per 2,000 lbs.
Egg Anthracite	32.5	cubic feet per 2,000 lbs.
Soft Coal	40	cubic feet per 2,000 lbs.
Coke	68	cubic feet per 2,000 lbs.

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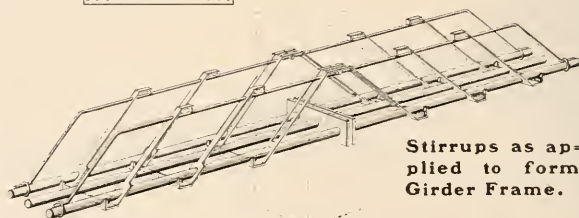
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STRENGTH OF REINFORCED CONCRETE BEAMS AND COLUMNS.

Written exclusively for The Handbook for Architects and Builders.

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The analysis of stresses in reinforced concrete beams and columns differs somewhat from that for steel and timber construction. The variety of manner of failure for beams of varying proportions is greater. In this treatment a thorough analysis is not attempted, but general principles are stated and approximate formulas are given. No attempt is made to give a complete treatment of any part of the subject.

PHENOMENA OF BEAM ACTION.

When a load is applied to a reinforced concrete beam, compressive stresses are set up in the concrete on one side of the neutral axis and tensile stresses are developed on the other side. The tensile stresses exist both in the concrete and in the longitudinal reinforcement. It is now generally accepted that the concrete fails in tension as soon as its ultimate tensile strength is reached. For some distance below the neutral axis the concrete will remain under tensile stress, even after the concrete lower down has failed in tension. As the moment of the tension remaining in the concrete is relatively small, it is now the common practice to disregard the tensile strength of the concrete in calculations on the resisting moment of beams, and this practice will be followed in the treatment here given. Concrete in compression does not possess the property of proportionality of stress and deformation for wide ranges of stress as does steel, though the variation from direct proportionality is not great for small stresses in the concrete. For higher stresses the variation is considerable. The relation between stress and deformation for medium mixtures of concrete and first application of load may be expressed in terms of a parabola. If the ratio between stress and deformation at the beginning of loading be called the initial modulus of elasticity, the ratio at the crushing point (using the parabolic stress-deformation relation) will be one-half as great; that is, at the full compressive strength of the concrete the stress will produce a total deformation twice as great as that which would be found by the use of the initial modulus of elasticity; or, to put it another way, a modulus of elasticity which would produce the final deformation would be one-half as great as the initial modulus of elasticity. The use of the parabolic relation makes the analytical treatment somewhat more complicated. No effort will be made here to derive the parabolic relation, and in order to simplify methods approximations will be used which will give sufficiently close results.

In addition to the longitudinal tensile and compressive stresses developed in a reinforced concrete beam, secondary stresses are set up which are termed web stresses. These include the bond stress between the steel and the surrounding concrete, horizontal and vertical shearing stresses, and

diagonal tensile and compressive stresses. In long, shallow beams having a low amount of reinforcement, the effect of the web stresses may not need consideration; but in beams having other dimensions, larger amounts of reinforcement, or other conditions, these stresses may become very important and may control the maximum strength of the beam. To strengthen the beam against web stresses, web reinforcement may be used.

In this treatment the usual hypotheses of beam action will be assumed; that the loads are applied at right angles to the beam; that the supports will permit free longitudinal movement; that a plane section before bending remains a plane section after bending; and that the metal and surrounding concrete stretch together. As already stated, it is further assumed that the tensile strength of the concrete is negligible in the calculation of the resisting moment of the beam at the time of maximum load in the part of the beam where the bending moment is greatest. The analysis is restricted generally to rectangular beams with reinforcement on the tension side only.

It may be well to call attention to the several manners of failure found in tests of reinforced concrete beams. In steel and timber beams it usually is necessary to consider only horizontal, tensile, and compressive stresses, with perhaps a check on horizontal or vertical shearing stresses. In reinforced concrete beams failure may occur by one of the following methods: (1) tension in the steel, (2) compression in the concrete, (3) shearing of the concrete, (4) bond or slip of bars, (5) diagonal tension of the concrete. What one of these methods of failure will govern the strength of a beam is dependent upon the percentage of reinforcement, kind of steel, quality of concrete, relation of depth of beam to length of span, position of reinforcing bars, and other conditions. Generally for a given beam we may select the probable method of failure without much calculation.

NEUTRAL AXIS.—The position of the neutral axis may be given in terms of the depth or distance from the compression face of the beam to the centroid or center of gravity of the longitudinal reinforcement.

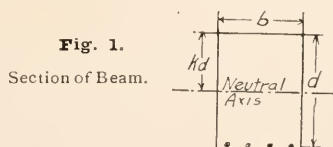


Fig. 1.
Section of Beam.

In Fig. 1, d is the distance from the compression face to the center of gravity of the longitudinal reinforcement. The position of the neutral axis may be given as kd below the compression face, k being a

mere ratio. The value of k depends upon the amount of reinforcement, the quality of the concrete, and the intensity of the compressive stresses developed. If q represents the ratio of the unit deformation at the upper fiber to the unit deformation which would be developed at the full compressive strength of the concrete, b = breadth of beam, p = ratio of area of reinforcement to bd , and n = ratio of modulus or coefficient of elasticity of steel to initial modulus of elasticity of concrete, the general formula for k will be as follows:

$$k = \sqrt{\frac{2pn}{1-1} + \frac{p^2n^2}{3q + (1-1)3q} - \frac{pn}{1-1} \frac{3q}{3q}} \quad (1)$$

When the full compressive strength is developed at the upper fiber, $q = 1$, and the expression for k is as follows:

$$k = \sqrt{3pn + \frac{9}{4} p^2n^2 - \frac{3}{2} pn} \dots \dots \dots (2)$$

For $q = \frac{1}{4}$, a condition representative of beams with a medium amount of reinforcement under ordinary loading, the expression for k is:

$$k = \sqrt{\frac{24}{11} pn + \frac{144}{121} p^2n^2 - \frac{12}{11} pn} \dots \dots \dots (3)$$

When a slight load is applied, $q = 0$ and the expression becomes:

$$k = \sqrt{2pn + p^2n^2 - pn} \dots \dots \dots (4)$$

This equation is also the equation for the position of the neutral axis when a constant modulus of elasticity (straight-line stress-deformation relation) is used. It is the equation most commonly quoted for the position of the neutral axis.

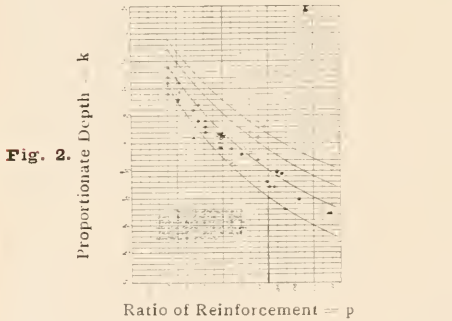
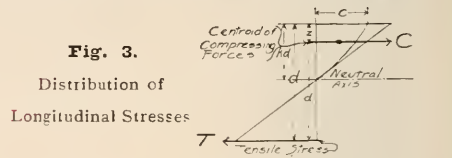


Fig. 2 gives the proportional depth of the neutral axis for various values of p , considering that $q = \frac{1}{4}$. It gives a convenient method of finding k and may be used for many purposes without material error. The value of n may be taken as follows in well-made limestone concrete for first application of load: For 1-1½-3 concrete at 60 days, $n = 12$; at 1 year, $n = 10$. For 1-2-4 concrete at 60 days, $n = 15$ and at 1 year, $n = 12$. With 1-3-6 concrete at 60 days, $n = 18$, and for 1 year, $n = 15$. The value of n increases after repeated applications of a load. For high compressive stresses in the concrete the neutral axis will be lower than is given by Fig. 2, ranging from .03d to .07d lower. It will be seen that slight variations in the assumed position of the neutral axis will not largely affect the calculations.

CENTROID OF COMPRESSIVE STRESSES.—The position of the centroid or center of gravity of compressive stresses ranges

from one-third to three-eighths of the distance from the compression face to the neutral axis, the latter position being for a load which develops the full compressive strength of the concrete.

RESISTING MOMENT OF BEAMS REINFORCED IN TENSION SIDE ONLY.



1. WHEN THE FULL COMPRESSIVE STRENGTH OF THE CONCRETE IS NOT DEVELOPED.—In Fig. 3, T represents the total tensile stress in the longitudinal reinforcement, and C the total compressive stress in the concrete, considered to be concentrated at the centroid or center of gravity of the compressive stresses. Since these two forces, T and C , are equal, their moment, which is the resisting moment of the beam, is equal to the product of one of the forces and the distance between them. Hence we may write for the resisting moment of the beam

$$M = Td' = Afd' = pbdfd' \dots \dots \dots (5)$$

where A represents the area of the longitudinal reinforcement and f the tensile unit-stress in the steel ($f = \frac{1}{3}$ Elastic limit Chicago Municipal Code Requirement). d' will vary somewhat with the position of the neutral axis and this position varies with the amount of reinforcement. Its value may be found by means of the diagram in Fig. 2. For light and medium reinforcement and good concrete, an approximate value of d' may be selected which will cover the usual conditions and range of reinforcement with a fair degree of accuracy. For a good quality of limestone concrete, an average value of d' may be taken as .87d. The equation for the resisting moment of the beam then becomes:

$$M = .87 Afd \text{ or } .87 pbd^2 f \dots \dots \dots (6)$$

This is a convenient formula for general use.

2. WHEN THE FULL COMPRESSIVE STRENGTH OF THE CONCRETE IS DEVELOPED.—When the full compressive strength of the concrete is developed, the resisting moment may well be expressed in terms of the compressive stress developed at the remotest fiber of the beam. In this case the parabolic stress-deformation relation will be applicable and the total compressive stresses in the cross section will be $\frac{2}{3}ckbd$, where c is the compressive unit-stress in the remotest fiber (*Chicago Municipal Code Maximum for 1-3-5 Concrete 500 in.-lb.). The centroid of the compressive stresses may be considered to be at $\frac{3}{8}kd$ below the compression face. As before, the resisting moment will be the moment of the couple shown in Fig. 3. The resisting moment may then be written as follows:

$$M = \frac{2}{3} ckb d^2 (1 - \frac{3}{8} k) \dots \dots \dots (7)$$

$$*[For C. M. C. Req. 333 \frac{1}{3} b d^2 (k - \frac{3}{8} k^2) = \text{for practice } 333 b d^2 (k - \frac{3}{8} k^2)]$$

If it is desired to express this resisting moment in terms of the stress in the steel the following formula may be used:

$$M=Afd \left(1-\frac{3}{8}k\right) \dots\dots\dots(8)$$

It will be found that in beams having sufficient reinforcement to develop the full compressive strength of the concrete the resisting moment of the beam will be increased but slowly by adding reinforcement. This is well shown in a later discussion.

3. RANGE OF APPLICABILITY OF FORMULAS.—An examination of equations (6) and (7) shows that for light and medium reinforcement the resisting moment of the beam is limited by the stresses allowed in the steel, and that the stress in the concrete is comparatively low; in other words, there is a larger working factor for the concrete than for the steel. On the other hand, for larger percentages of reinforcement the compressive strength of the concrete will be the limiting or controlling element and the steel will receive a smaller stress than the maximum allowable. Evidently there is an amount of reinforcement for which the tensile stress in the steel and the compressive stress in the concrete are each at their respective limits of allowable stress. If the percentage for this balance reinforcement be known, equation (6) may be used for lower reinforcements. For higher reinforcements, equation (7) may be used, but the method given in a succeeding paragraph (equation (9)) offers advantages.

The percentage of reinforcement at which balanced reinforcement exists may be decided upon in various ways. Sometimes formulas are used with assumed values for the compressive stress and for the tensile stress, and the point of equilibrium determined. Sometimes the results of experimental investigations on the percentage of reinforcement necessary to develop the full compressive strength of the concrete are used. In any event, some judgment must be exercised and the conditions which are likely to attend the fabrication, setting, and loading of the reinforced concrete beams taken into consideration. Numerous tests made by various experimenters show that 1-2-4 concrete beams with as much as 1½% reinforcement of mild steel will not fail on first loading through compression of the concrete and that generally beams having 2% reinforcement may not be expected to fail in this manner. However, repetition of loading and continuance of loading, such as may be found in the case of buildings, will have an increased effect upon the concrete, and the conditions of fabrication, even with fair supervision, may not be as good as those existing in test beams. **A higher working factor should be used for the concrete than for the steel, if the factor for the latter is based on the elastic limit and for the former on ultimate strength.** For these and other reasons, a percentage for balanced reinforcement less than that given by test beams should be selected. It is believed by the writer that this balanced reinforcement may be taken at a percentage higher than is given by some city building laws. For mild steel reinforcement and a good grade of construction, the limit for a balanced reinforcement may be made as high as .8%, or even 1% under best conditions. The exact percentage will depend upon the quality of the construction and the method of loading.

Consider, for example, that for the assumed conditions of construction and loading 1% gives a balanced reinforcement and that such a beam may develop stresses in

the concrete and in the steel up to the limit which should be allowed in the structure. For reinforcements below this amount equation (6) may be used, and the working factor for the concrete will be greater accordingly than that for the steel. For a reinforcement larger than 1% the resisting moment may be calculated by equation (7). It will be more convenient, however, to determine the resisting moment for 1% reinforcement and then to calculate it for the higher reinforcement, and the writer offers the following method for such use. Call M' the bending moment for a 1% beam, calculated by equation (6). A study of the results of equation (7) for reinforcements between 1% and 2% will show that the following equation expresses fairly accurately the resisting moment of the beam.

$$M = M' [1 + 30(p - .01)] \dots\dots\dots(9)$$

If a percentage other than 1 is considered the balanced reinforcement, the following method may be used. Let M' be the resisting moment for the balanced reinforcement (calculated by equation (6)), and p' the value of p for this balanced reinforcement. Then we may write

$$M = M' \left(1 + .3 \frac{p-p'}{p'}\right) \dots\dots\dots(10)$$

which is applicable from a balanced reinforcement to one twice as great. It will be seen from equation (10) that doubling a balanced reinforcement adds 30% to the strength of the beam.

Fig. 4.

Proportion to be added to Balanced Reinforcement for Moment of Larger Reinforcement.

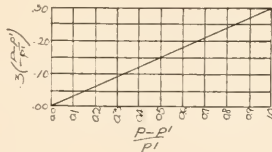
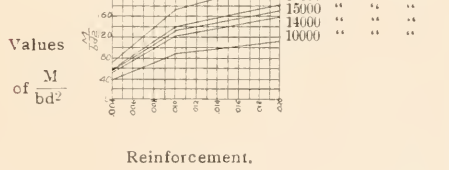


Fig. 4 shows the proportion of the bending moment at a balanced reinforcement which is to be added for reinforcements above the balanced reinforcement. It gives

Fig. 5.



the term $.3 \left(\frac{p-p'}{p'} \right)$ of equation (10). Fig. 5

gives values of $\frac{M}{bd^2}$ for several working

stresses in the reinforcement, using 1% as the balanced reinforcement and using equation (9) for higher reinforcements. For other values for a balanced reinforcement, a similar diagram may be easily constructed.

To recapitulate: **For reinforcements less than the balanced reinforcement use the formula:**

$$M = .87Afd \text{ or } .87pbdf \dots\dots\dots(6)$$

For reinforcements greater than the balanced reinforcement up to twice as great, find the resisting moment for a beam with

the balanced reinforcement and add to this value the amount $.3(\frac{p-p'}{p'})M'$ that is, use the formula

$$M = M' [1 + .3 (\frac{p-p'}{p'})] \dots\dots\dots (10)$$

*(For average work it is inexpedient to use reinforcement greater than balanced reinforcement.)

WEB STRESSES.

BOND OR RESISTANCE TO SLIPPING OF BARS.—In order to have beam action there must be a proper web connection between the tension member and the compression portion of the beam. When there is no metallic web reinforcement, the concrete of the beam acts as this web. Of course, the amount of stress in the reinforcing bars and also in the compression area of the concrete varies along the length of the beam. The increment of stress between consecutive sections, or, say, the increase in the tensile stresses in the reinforcing bars, is transferred to or connected with the increments of the compressive stresses of the concrete by means of this web. In this web connection there is developed a tendency of the rods to slip in the concrete, and the amount of resistance thus developed is called bond and will be measured in terms of the area of the surface in contact with the concrete. It will be seen that the total bond developed on the surface of the bars in one inch of length is equal to the total change in total tensile stress in the bar for the same inch of length. Bond may be compared to the action of the rivets in the flange of a riveted steel girder, except that in the reinforced concrete beams the contact is continuous.

When the longitudinal reinforcement is placed horizontally throughout the length of the beam, if we do not consider tension in the concrete, the bond stress at any point may be found by equation

$$u = \frac{V}{m \odot} \dots\dots\dots (11)$$

where V is the external vertical shear, m is the number of bars, \odot is the effective circumference or periphery of one bar, and d' may ordinarily be taken as $.87d$.

Tests of bond between mild steel plain rods and good concrete give bond resistance of 250 to 700 lb. per sq. in. of surface in contact, depending upon age and other conditions. Tests of beams which fail by bond or slip of bars justify the above values. Tests with deformed bars give bond resistance from 400 to 1000 lb. per sq. in. Whether bond of ordinary plain rods is permanent and whether deformed bars are advantageous will not be discussed here. It should be noted that bending up or inclining the reinforcing bars toward the ends of the beam (or near the inflection in restrained beams) increases the bond stress brought into action very materially. *(The C. M. C. absurdly states the adhesion of concrete to steel shall be assumed to be seventy-five pounds per square inch of surface where bars are $\frac{3}{8}$ inch or less in diameter and proportionately less for bars of a diameter greater.)

VERTICAL AND HORIZONTAL SHEARING STRESSES.—It is shown in the mechanics of beams that there exist throughout a beam vertical and horizontal shearing stresses and that at any point in a beam the vertical shearing unit-stress is equal to the horizontal shearing unit-stress there developed. The horizontal shearing stress may be thought of as transmitting the incre-

ments of tensile stress in the reinforcing bars (which are transmitted to the surface of the concrete by the bond stresses) to the corresponding increments of compression in the compression area of the concrete, the concrete thus forming the stiffening web of the beam. The horizontal shearing unit-stress (and therefore the vertical shearing unit-stress) at a point just above the level of the reinforcing bars when the bars are not inclined or bent upward, disregarding tension in the concrete, is given by the equation

$$v = \frac{V}{bd'} \dots\dots\dots (12)$$

where V is the external vertical shear.

If no tension is considered as acting in the concrete, there will be no change in the intensity of the horizontal and vertical shearing stresses between the level of the reinforcing bars and the neutral axis. For the part of the beam where horizontal tensile stresses exist in the concrete the shearing stress will increase upward toward the neutral axis. Above the neutral axis the intensity of the shearing stress will decrease by the law of change of horizontal shearing stresses for homogeneous rectangular beams modified to suit the parabolic

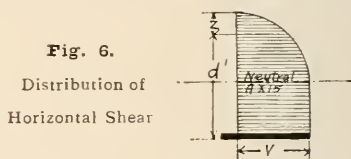


Fig. 6.

Distribution of
Horizontal Shear

stress-deformation relation. The distribution of the intensity of the horizontal shearing stress over a vertical section is represented in Fig. 6. If d' be considered to be $.87d$, the shearing stress by equation (12) will be about 15% more than if considered to be uniformly distributed over the vertical section. The value of the shearing stress is small for ordinary beams, much less than the actual shearing strength of concrete. As a matter of fact, what are usually termed shear failures in beams are not failures of the concrete in shear, but are due to failure by tension in the concrete, the tension being the necessary accompaniment of shearing stresses. As will be seen, the shearing unit-stress may well be used to measure or compare diagonal tensile stresses, and as such equation (12) is important.

DIAGONAL TENSION IN CONCRETE.

It is shown in mechanics of beams that whenever vertical and horizontal shearing stresses are set up in the web of the beam tensile and compressive and shearing stresses exist in every diagonal direction. Only the horizontal components of these stresses enter into the determination of the bending moment. When there is no metallic web reinforcement all the diagonal stresses are taken by the concrete. The angle of the diagonal direction at which the maximum stress exists depends upon the relative values of the shearing stress and the horizontal tension existing in the concrete. The following equation gives the maximum diagonal tensile unit-stress existing in the concrete, calling the horizontal or vertical shearing unit-stress v and the horizontal tensile unit-stress in the concrete s ,

$$t = \frac{1}{2} s + \sqrt{\frac{1}{4} s^2 + v^2} \dots\dots\dots (13)$$

The direction of this maximum diagonal tension makes an angle with the horizontal equal to one-half the angle whose cotangent

is $\frac{1}{2} \frac{s}{v}$. If tension in the concrete is disregarded, equation (13) becomes

$$t = v \dots \dots \dots (14)$$

and the maximum diagonal tension makes an angle of 45° with the horizontal and is equal in intensity to the vertical or horizontal shearing stress.

Beams without metallic web reinforcement will fail by diagonal tension in the concrete (frequently called shear failures) when the diagonal tensile stresses developed become as great as the tensile strength of the concrete. As the maximum diagonal tensile stress is by equation (12) dependent upon the horizontal tensile stress developed at the same point, and this is unknown, it is difficult to compute its actual amount. The best method seems to be to compute the horizontal and vertical shearing unit-stress and make all comparisons on the basis of this stress. Numerous tests indicate that failures of the diagonal tension class occur when v reaches a value something like one-half as great as the tensile strength of the concrete. For 1-2-4 concrete of good quality this failure may be expected at values of v from 100 to 140 lb. per sq. in. at 60 days' age (with lower values for poorer concrete.) **Diagonal tension failures** are frequently characterized by sudden breaks without much warning, as is the case in the failure of plain concrete beams. A high working factor should therefore be used. A variation from this form gives a slower failure, part of the shear being carried through the reinforcing bars, and the ultimate failure involves the stripping of the bars from the beam through failure of the concrete to resist the vertical tension then developed in the beam. It should be noted that as this stress involves the tensile strength of the concrete and as such failure may occur without warning, the factor of safety used should be high.

VERTICAL AND DIAGONAL REINFORCEMENT.—Since the diagonal tension may be resolved into horizontal and vertical or other components, the web stresses, or at least part of them, may be resisted in the following ways: (1) by making use of stirrups to take the vertical component of the diagonal tension and (2) by bending up the reinforcing rods or strips sheared from them into a diagonal position.

Vertical reinforcement usually consists of bars bent into U-shape; they pass under the longitudinal reinforcing bars, sometimes alternating in position. Usually the stirrups are not fastened to the longitudinal bars, the horizontal stresses being transmitted through the concrete by compression and bond. The stirrups should not extend laterally beyond the reinforcing bar, and it is well in setting stirrups to stagger or alternate them so that part of them will pass upward through the interior of the beam. **It should be noted that the presence of these stirrups tends to develop additional bond stresses in the longitudinal bars and also that the stirrups are not called into action to any great extent until the concrete has failed in diagonal tension.**

These stirrups must take the vertical tension developed in the beam, and hence their section and their bond resistance must be sufficient to resist this action. The stresses which are actually developed are somewhat obscure since even after diagonal tension failure occurs in the concrete there is still other diagonal tension existing in some directions. **It is best, however, not to consider that any diagonal tensile strength is**

available in the concrete, if stirrups are required. From the formula for horizontal and vertical shearing unit-stress, equation (12), we may derive the following equation for the total vertical stress taken by both prongs of a stirrup:

$$T' = x \frac{V}{d} \dots \dots \dots (15)$$

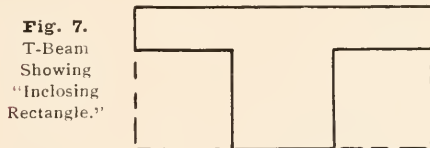
where x is the horizontal distance between stirrups. From this equation the necessary section and spacing of the stirrups may be calculated. The bond resistance of the stirrups will not be available far below the neutral axis of the beam, but experiments indicate that the area of the stirrups for a distance of, say, six-tenths of the depth of the beam may be considered to be available. **Deformed bars have advantages as stirrups and good results may be obtained by bending plain bars inward at the top.**

Where the longitudinal reinforcement is bent or inclined upward and stirrups are not used, the vertical shearing unit-stress which may be developed before failure by diagonal tension will occur may be as much as 25% greater than that with bars placed in a horizontal position, provided that the bond resistance when the bars are inclined upward is sufficiently great to resist the increased bond stress thus brought upon them. Anchoring such bars seems to have some value. In some tests with plain bars the beams with bent-up bars have carried no greater loads than those with the bars horizontal. The failure in some of the cases was due to slip of the bars. With the form of bar in which strips are sheared from the longitudinal bar and bent into a diagonal position, the resistance to diagonal tension failure is considerable, provided the amount of the metal bent up and its bond resistance are sufficient to resist the diagonal tensile stresses developed in the beam.

The design of web reinforcement should receive more attention than is usually given to it. For relatively short and deep beams the web stresses may be considerable and the danger of sudden failure by diagonal tension makes it important that these stresses be well considered.

T-BEAMS.

Beams of T-shape, whether constructed directly as T-beams or in such a way that a part of the floor slab may be considered to constitute the upper flange of the beam, are more complicated in their analysis; but approximate formulas may be used which



will reduce the labor of computation. For T-beams with longitudinal reinforcement in the stem of the tee it is convenient to compare the amount of reinforcement with the enclosing rectangle shown in Fig. 7. If the reinforcement is not crowded together too much and the reinforcement does not exceed 1% of the enclosing rectangle, the resisting moment of the beam, based on the tension in the steel, may be calculated from equation (6), $M = S_f A_f d$. To determine the shearing unit-stress, and thus to compare the diagonal tensile stresses in the beam, equation (12) may be used, b being taken as

the width of the stem. The stresses in the stirrups may be determined in a similar way, equation (15) being used. Bond stresses in the longitudinal reinforcement may be calculated by equation (11). Attention is called to the chance for excessive compressive stresses in the stem of a T-beam, when it is restrained at the ends.

WORKING STRESSES AND BENDING MOMENT.

WORKING STRESSES.—The stresses permitted in beams cover a wide range and vary with the character of the construction, the method of the application of the load, and the practice of the designer. A discussion of the working stresses which should be used in the design of beams does not come within the scope of this article, but it is a matter to which careful attention should be given. It may be said, however, that the practice of engineers and architects and the building regulations usually given come within the following range of stresses: Tension in steel reinforcing bars, 10,000 to 16,000 lb. per sq. in. *(C. M. C. Req. $\frac{1}{4}$ elastic limit of steel about average, about 16,960 inch-pounds.) Maximum compressive stress in concrete in beams, 350 to 700 lb. per sq. in. *(C. M. C. Req. maximum 500 inch-pounds, with 1-3-5 concrete.) When expressed in terms of balanced reinforcement, from .6% to 1% of reinforcement has been considered to develop the full compressive strength of the concrete with a proper ratio between the factor of safety for the concrete and for mild steel reinforcing. With no metallic web reinforcement, the horizontal and vertical shearing unit-stress in the concrete (used as a method of comparing allowable diagonal tension in the concrete), 30 to 50 lb. per sq. in. *(Absurd requirement C. M. C. 75 lbs. per sq. in. with 1-3-5 concrete.) The shearing area of the longitudinal rods is not considered in this calculation, though some building regulations apparently consider it and absurdly allow the steel to take 200 times as much shearing unit-stress as the concrete. *(C. M. C. Req. allows shearing stress in steel 10,000 lbs. per sq. in.) It will be seen that the range of stresses used is very large. The matter of allowable working stresses for reinforced concrete construction has not yet been placed on a final and satisfactory basis.

BENDING MOMENT.—The experimental work on beams has usually been made with the beams free to move longitudinally with changes of length due to deformation, and the test beams have usually been arranged as simple beams loaded at two points under conditions approaching those which obtain with a uniformly distributed load. Under these conditions the calculation of the bending moment is a simple matter. Attention should be called to the fact, however, that the conditions attending the use of reinforced concrete beams are quite different from those connected with the use of steel and timber beams. For example, if an I-beam is placed so that its ends are restrained, the effect is to decrease the stress actually brought upon it, and no attention need be given to the reversal of stress in the top and bottom flanges. With reinforced concrete beams under the same conditions the fixing of the ends of the beam and the development of tension in the top of the beam present an entirely new condition and it will be necessary to reinforce the top of the beam wherever tension may be developed. For these and other reasons great care must be exercised in determining the exact condition of the ends of the beam and of the loading of the beam in order that the stresses in every part of the beam may be provided for.

When a beam is fixed at the ends, there is bending moment both at the middle and at the ends of the beam, the amount for a uniformly distributed load being $\frac{1}{8}Wl$ at the middle and $\frac{1}{2}Wl$ at the ends. If the restraint at the end is less than for fixed ends, the bending moment at the middle will be increased and that at the end will be decreased. If the restraint at the end is for any reasons lost, the bending moment at the middle for a uniformly distributed

load becomes $\frac{1}{6}Wl$ instead of $\frac{1}{8}Wl$, and building regulations frequently stipulate the larger amount for the moment to be used in calculations, whether the ends be fixed or not. Nevertheless, if there may be restraint at the ends, it must be provided for, both in the reinforcement on the tension flange of the beam and for diagonal tension, and the conditions which give the maximum stresses must be used for each part of the beam. Bending up bars diagonally complicates the problem materially, and the shearing and diagonal tension reinforcement becomes more important. **At every section the reinforcement must be such as to take the stresses which will be set up under any condition likely to occur.** The methods of calculation for the various conditions cannot be gone into here. The designer should make calculations for every condition of loading and every beam action likely to occur under the condition of construction and use.

In beams in a building the restraint at the ends of beam and the limitation of freedom of longitudinal movement add to the complication of an analysis. The distribution of loads from a floor to girders may be uncertain. Reinforcement in slabs, in two directions is another complexity. These questions and various other matters of computations and design are not within the scope of this article and will not be taken up.

COLUMNS.

In reinforced concrete construction the ratio of the length of a column to its lateral dimension is generally such that lateral flexure does not enter into the question of strength, the stresses are those of direct compression, and formulas for long columns are not applicable. This must not be taken to exclude consideration of eccentric loading. The effect of eccentric loading for columns of ordinary length is practically independent of the length of the piece. The usual formula for the strength of a concrete compression piece, here called a column, is

$$P = A_c \dots\dots\dots (16)$$

where **A** is the area of the cross section of the column which is available for compression, and **c** is the compressive unit-stress.

When the column is reinforced by means of longitudinal bars, the steel takes part of the load and the ratio of the stress in the steel to the stress in the concrete varies according to the load which the concrete carries. For light loads the steel may take 10 to 12 times as much in pounds per square inch as the concrete. Toward the ultimate strength of the concrete the unit-stress in the steel may be 25 to 30 times as much as in the concrete. In poor or weak concrete, since the modulus of elasticity of poor concrete is generally less than that for a rich concrete, the steel will take more stress accordingly than when acting in connection with good concrete. Since the modulus of elasticity for steel is fairly uniform and that for concrete is variable, and since provision for lack of uniformity must be considered in determining working

stresses, it is proper to select as a basis for ordinary working conditions a ratio of the stresses in the two materials which exists at stresses beyond the usual working stresses. Further, since for columns weaker than the average column the ratio may be expected to be higher than the average ratio, while for columns stronger than the average the added strength of the concrete will go to make up for the overestimated stress in the steel, the ratio of the stresses in the two materials may properly be taken higher than the average value. Under ordinary conditions of construction for 1-2-4 concrete the ratio of the stress in the steel to the stress in the concrete may be taken to average 17. * (C. M. C. requires ratio of the moduli of elasticity of concrete and steel shall be taken as one to twelve, 1-3-5 concrete.) Under the assumptions named above a value as high as 21 may be used.

For short columns the formula for the load to be carried may be written

$$P = A_c (1 - (n-1) p) \dots\dots\dots (17)$$

where **A** is the area of the column (i. e., of the part to be considered available for compression), **c** is the compressive unit-stress allowable in the concrete, **n** is the ratio between the stress in the steel and that in the concrete, as just discussed, and **p** is the ratio between the area of the reinforcement and the area of the column.

Columns reinforced with hoops or bands or spirals, spaced at close intervals, around the core of concrete, will carry high loads. Two conditions must be understood to exist, however, in these columns: (1) the hoops or bands do not come into action to any great extent until the concrete has reached the ultimate strength of plain concrete; and (2) the amount of shortening in such columns after the hoops are strained is very great. The lateral deflections are

also large. The effect of a combination of hooped columns and longitudinal reinforcement is not very well known. Relatively few data are available upon which to base the design of hooped columns and **extreme caution should be used in accepting current formulas for this form of reinforcement.**

It should be borne in mind that under the conditions of building construction columns may form a weak element of reinforced concrete structures. The variation in fabrication, the difficulty of inspection, the opportunities for damage through loads being applied at too early an age, and the possibility of a division of loads among the columns quite different from that assumed in the calculations, all go to show that low working stresses should be used, and **every precaution should be taken to secure proper materials, workmanlike fabrication, and efficient inspection.**

The scope of this article does not include anything on precautions and restrictions on the fabrication of reinforced concrete. Many elements enter into the quality and integrity of reinforced concrete construction. **Materials, workmanship, attention to details, carefulness in joining work, care during time of setting, effect of weather conditions, stability of forms and time of their removal,—these and other conditions affect the stability of the construction even more than is ordinarily supposed.** Ideal conditions cannot be expected, but care may be exercised to secure high-grade construction, and the discussions of this paper assume that high-grade construction is obtained.

*Editorial inserts for benefit of those having to follow the Chicago Municipal Code Requirements. See Secs. 543 to 555—562 to 569—582 to 584—593—594.

SHOP-FIXED OR BUILT-UP CONCRETE REINFORCEMENT.

It is of the utmost importance to make sure that the steel used in reinforced concrete is placed where the designing engineer intends it to be. For this cause the advantages of the built-up type of reinforcement are apparent. If the reinforcement comes to the job ready to be installed in the forms, with each reinforcing member properly located and rigidly attached, work in the field with the attendant extra expense and uncertain results is avoided, and accurately placed reinforcement is secured. In consequence, the result ought to be a reduction in total cost, as it should be cheaper to arrange reinforcement in a factory with adequate machinery than on the job by manual labor. Built-up reinforcements should be so designed as to be held up in forms sufficiently far to provide ample covering of all members with concrete fire proofing. No part of metal reinforcement should be allowed to approach closer than 1½" to the surface of the concrete construction. Adhesion between reinforcement and concrete is not positively certain. Mechanical connections over each point of support effect continuity of reinforcing members independent of adhesion. Frames in adjacent bays should be arranged so as to be securely fastened together with bolts or links, so that the combined reinforcement for a floor, forms a rigid framework, and is less likely to be dislodged by the impact of the concrete when it is dumped into the forms. These links must be sufficiently strong to resist the stresses to which they may be subjected and to distribute the load on any portion of floor throughout the adjoining sections of floor; thus obtaining the full economical value of the continuous beam. Care must be taken in the design of shop-built reinforcement to so place the position-securing metal as not to rupture concrete; in other words, this metal for holding bars in position should not be sufficiently large to materially affect the continuity of concrete mass.

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HOW TO CONSTRUCT A TIN ROOF.

Roofs with less than one-third pitch are made with flat seams and should preferably be covered with the best kind of roofing tin, from sheets 14x20 inches dimension, rather than from sheets 20x28 inches, because the larger number of seams stiffen the surface and help to prevent buckles and rattling in stormy weather. For flat seam roof one-inch barbed and tinned roofing nails should be used, not over six inches apart, well under the edge. They should be well covered up and the seams should be pounded down over the edge with wooden mallet. Nails must never be exposed. The seams should be made with great care; sufficient time must be taken to properly "sweat" the solder into the seams.

Steep tin roofs should be made with standing seams and from sheets 20x28 inches. The sheets are first double seamed and soldered together into long strips that reach from eaves to ridge. The sloping seams are composed of two "upstands," interlocked and held in place by cleats. The standing seams are not soldered, but are simply locked together with the cleats folded in from 15 to 18 inches apart. Nails should be driven into the cleats only.

While it is always cheapest to use the best material, roofing plates with a lesser coating may be used for steep standing seam roofs. IC roofing plates, in which the iron body weighs 50 lbs. per 100 square feet, are more suitable than IX plates (62½ lbs. per 100 square feet), because the seams in the lighter plates will not suffer as much from contraction and expansion as the thicker plates.

For spouts, valleys and gutters heavily coated IX plate should always be used.

The amount of terne coating on the lighter sheets should in all cases be fully as heavy as on the heavier plates.

In late years the anxiety of some manufacturers to satisfy the demand of the people for cheap goods has been the cause of many inferior grades being introduced. This latter class of material may suit for some purposes outside of roofing or for roofs on temporary buildings, but for roofs that are expected to last, the "double dipped" and "extra coated" plates should be used.

The use of acid in soldering seams in a tin roof is to be carefully avoided; acid coming in contact with the bare iron on the cut edges and corners where the sheets are folded and seamed together will cause rusting. No other soldering flux but good rosin should be used. Every roof should be carefully cleaned and all rosin spots and detrimental substances should be removed as the tinner's work is being finished. Lumps of rosin left on the roof will melt in the sun, stick to the roof, cause blisters and prevent paint from adhering.

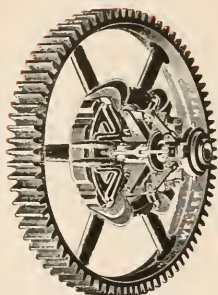
For valleys, spouts and gutters of a tin roof no other metal than terne plates should be used, because the galvanic action produced by different metals coming in contact with each other will cause disintegration under atmospheric influences.

The sheeting boards underlying the roofing tin should be put close together.

The wood should be well seasoned, dry and all knots should be culled out. It is also advisable to cover the boards with good building paper before the tin is laid on. The paper serves to exclude from the tin injurious vapors, gases, or fumes that continually rise from the rooms below.

When no paper is used the tin must in all cases be painted on the under side with good reliable oil paint before it is laid and fastened on the roof. The outside should receive two coats of paint as soon as the roof is finished.

To make tin roofs last for generations they should be repainted every three to five years with good iron oxide and linseed oil paint. The frequency of the intervals will depend largely on the climatic conditions of the country.



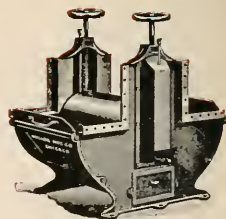
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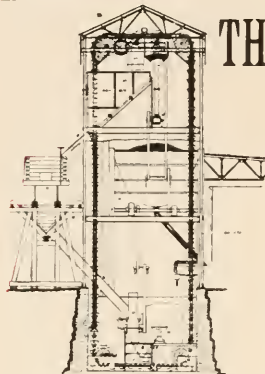
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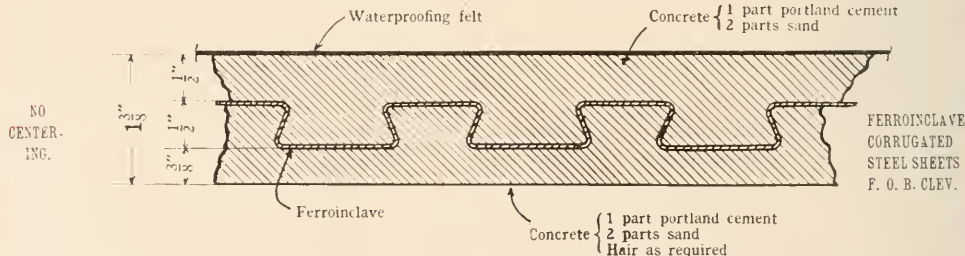
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The architect meets with demands for equipments of this character for handling packages, boxes, bags, etc., and for handling articles in bulk.

Where packages, etc., are to be handled, if these are large and only a small number are handled each day, it is probable that the ordinary platform elevator and the ordinary truck will provide the cheapest means of transportation. When, however, the cost of labor for operating these will pay a fair return on account of the large number of packages handled, some continuous type becomes necessary.

For elevating packages by the continuous method the elevators must be designed to receive the packages on one side and deliver on the opposite side under ordinary conditions; also where a number of floors are passed through by the machine the manufacturer should provide some means for protecting the packages on a tray from being crushed by the tray coming up under a loading arm which has heavy packages on it.

The speeds for operating these elevators must necessarily be slow (approximately 60 ft. per minute being the maximum), and where very large numbers of packages are handled or where it is desirable for the elevator to receive and discharge its load automatically without attention from any attendant, it is necessary to reduce the speed still further. These elevators are now designed to take packages at any floor, locking the loading gates on floors above automatically after any arm has been loaded, and the arms themselves carrying a discharging device which permits the elevator to discharge at the proper floor even when packages are loaded on indiscriminately and each tray may be loaded for a different floor. These elevators should be of long pitch steel chain preferably and the architect should specify with great care the weight and dimension of the largest and smallest packages to be handled.

In many places a similar type of tray elevator without fingers and without any automatic means of loading or unloading is found very desirable, and this is the cheapest form for this kind of work. In small elevators of this type it is desirable to drive the machine through a train of worm gearing enclosed in oil-tight housings to avoid the reversal of the machine in case the power should be interrupted momentarily.

For handling packages horizontally or at slight inclination, conveyors with a wood surface are best adapted for handling boxes, barrels, etc., and in this case should be either mounted on long pitch steel chains or else provided with rollers at intervals of about two feet, attached directly to the wooden slats. The use of roller chains is not advisable under ordinary circumstances for a conveyor of this class unless the service is comparatively light. As a general thing it is not advisable to carry weights greater than a half ton on a conveyor of this character, as the cost of construction is very largely increased if such weights are to be taken care of. These conveyors can be made up to discharge automatically at any one of a number of points, and to travel around a horizontal circuit so that material may be put onto the conveyor and left there until it is convenient to remove it when it reaches its proper station, even though the conveyor is not fitted with an automatic discharging mechanism.

Conveyors of this type should not be inclined more than 30 degrees and preferably not more than 20 degrees. If long pitch steel chains are used with the rollers in the chains the rollers should be of the self-oiling type and a proper automatic lubrication of same should be insisted on.

For handling bags, small boxes or other comparatively light packages a cheaper type of conveyor is made of heavy cotton belting running on rollers at intervals of from 3 ft. to 5 ft. These belts are particularly useful in department stores and are made up about 24 inches wide. The rollers supporting the belt are usually of wood, 2 inches or 3 inches in diameter, running in ball bearings and hung from the ceiling or supported on pipe frame work.

On conveyors of this kind any type of roller bearing which requires oiling in the usual sense of the word is objectionable, as the oil is liable to drip down upon people or packages that are handled on the belt. Properly constructed ball bearings are not expensive and they last indefinitely, requiring much less attention than any other type. Ball bearings for the heavier types of conveyors, however, are not advisable, as they add greatly to the cost and become a source of frequent trouble through the breakage of balls by the heavy shocks. The belt, as stated above, should be of cotton. Rubber belts are not advisable for use on this character of conveyor unless the belt is exposed to alternate wet and sunshine.

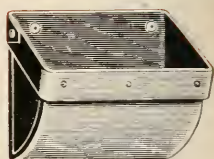
For handling articles in bulk, if these are gritty, it is usually desirable to use a belt instead of a chain, provided the strength of the belt is sufficient to take care of the weight of the material handled. Where very high elevators are required the belt is frequently not strong enough for the work, nor is it strong enough when the material comes in very large lumps.



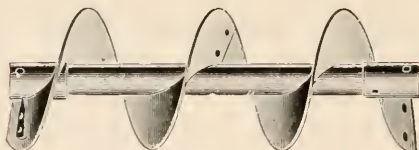
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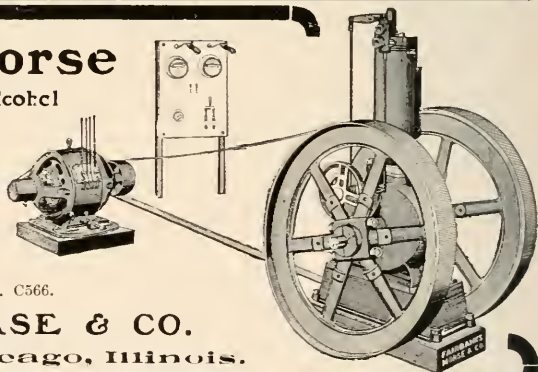
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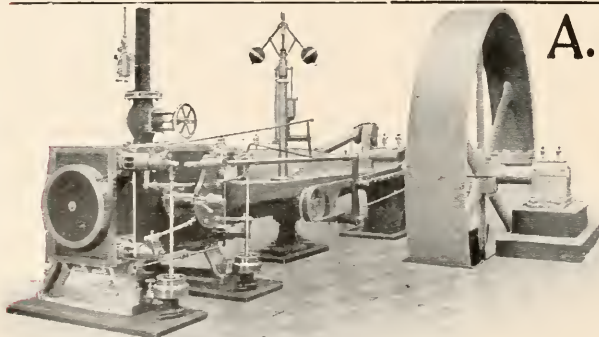
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Bear in mind that the discharge from any belt elevator is by centrifugal action and that it is impossible to operate them at slow rates of speed, whereas a chain device may be operated at almost any speed by using the proper form of bucket. Besides this, a belt will deteriorate ordinarily more rapidly than a chain when used as an elevator and having buckets bolted or riveted on it. Where a belt is used for carrying horizontally the operating speed may be anything up to 800 or 1000 ft. where the material is light and in small particles. There is very little to be gained by reducing the speed to less than 300 ft. unless the material to be carried contains large or sharp lumps. The amount of power consumed by a belt operating approximately horizontally is less than for any chain type of equipment operating under the same conditions. This because the weight of the moving parts of the empty conveyor is less; and, what weight there is, is carried on carefully lubricated rollers. The amount of power required depends upon the number of rollers supporting the belt and increases where the rollers are put closer together. Increasing the width of the belt has far less effect in increasing the power required for operation than has an increase in the number of supporting rollers.

Ordinarily rollers should not be spaced farther apart than about 4 ft. for handling coal or material of approximately the same weight. For very heavy materials the idlers may be spaced 3 ft. or even less.

The belt conveyor where no buckets or other attachments are made to it is usually the most lasting form of conveying machinery, but its life depends largely upon the type of troughing idlers used where the belt is raised up at the edges. The inclination of these idlers should not exceed 30 degrees and ordinarily should be considerably less. If the angle is increased the belt is very likely to split down the center, although the highest class belts will stand an incredible amount of abuse.

Guide idlers on the edges of a belt are objectionable, although necessary sometimes. Automatic lubrication should be used for belt conveyor rollers and for some work ball bearing rollers are desirable.

Compression grease cups or self-oiling rollers are desirable where the material to be handled is gritty, but these must be of the spring type and must have proper adjustment for the flow of the grease.

The strength of the rollers specified should be carefully considered where heavy material is handled, for the reason that larger pieces will "pound" the rollers in passing over them and the shafts must not be too small to be rigid.

The belt itself is the most serious matter on which to decide. For handling grain any ordinary belt will do the work fairly well, but when it comes to handling ore, coal or similar material, the belt must have a protecting coat of pure rubber on the carrying side, and this must be of the best possible grade and the greatest toughness obtainable; it must also retain its "life" under all ordinary conditions of temperature, moisture, etc.

A number of belts have been in use out of doors, subjected to climate abuse, and have given good service for three to five years. There are few on the market, however, which would do this.

If a cheap belt is wanted, use an ordinary stitched or woven canvas belt, as this will give better service than the cheaper "rubber" belts.

Sectional belt conveyors are made up in detachable sections 20 to 30 ft. long, mounted upon castors and arranged to couple up in lengths of five or six sections, sometimes more, the various belts being driven by their own individual motor, or taking power from other units; these are especially useful for warehouse work, as they can be moved around and adapted to local conditions. They can be operated on a horizontal plane or run inclined, or partly both, and it is not necessary to run in a straight line. For carrying sand, earth and such material, the belt is superior to any other type of conveyor.

CHAIN DEVICES.

For the heavier types of conveying machinery chains only are available, as they offer better facilities for attaching the buckets, trays or scrapers. From the nature of construction and the fact that they have to run on toothed sprockets, chain devices must run more slowly than belts, and the slower the machinery moves the greater the life will be, the wear increasing almost in proportion to the square of increase of speed.

Simplicity is very important, and the action of gravitation or swinging of parts hinged to the chains should be avoided, as gravity is uncertain in its action.

Swinging tray elevators and pivoted bucket conveyors must be run at very slow speeds, as their action depends on maintaining the bucket or tray in an upright position by the force of gravity.

It is possible to devise machinery to transfer material under almost every condition, but every device which does not receive at one point and discharge at one point becomes more complicated.

Chains should preferably be of steel and without any cast metal in them. They should also be of as long a pitch as the machinery will allow, as the short pitch chains have more joints and become more elongated by wear.

The wearing surfaces should be as large as they can conveniently be made by using long pins and long seats, covered by hardened steel bushings or phosphor bronze pads. Bushings of this nature are especially necessary where gritty materials are handled.

A still better construction is to have a heavy, hardened steel knuckle dove-tailed into the chain, providing a very thick body of metal to be worn through and usually arranged to be reversed so that the other side may also be worn before the bushing is thrown away. Chains assembled by riveted pins are always stronger than those put together with bolts or with loose pins with split cotters in the ends. Large and heavy chains for coal handling devices, particularly those of the pivoted bucket type, need the best possible bushings or steel knuckles to resist the wear of ashes; and should have chilled wheels of large diameter fitted with an effective self-oiling device. A positive automatic device for renewing the oil supply should be insisted upon.

The architect should consider whether an ordinary blacksmith can make repair parts for chains used. This cannot be done with malleable iron chains and seldom with cast steel chains or drop forgings.

Ordinary round link chain is useful and repairs can be made up for this, but the rapid wear due to the small contact between the links, makes it an objectionable device for many kinds of work.

In the handling of ashes and many other materials, the erosion of the parts by acids has to be considered. Cast iron or malleable iron buckets and receptacles are superior to those made of sheet steel. Illinois coals contain a large percentage of sulphur and are ordinarily received wet, the water having stood on them long enough to become practically diluted sulphuric acid. This corrodes steel very rapidly.

Ordinarily chain lubrication is very difficult. The indiscriminate squirting of oil on chain journals does more harm than good, because ash dust and similar grit is carried into the working parts. Several manufacturers, however, provide automatic oiling devices which discharge the oil through pads of fibrous material and provide positive lubrication in this way.

COAL CONVEYORS.

In obtaining proposals for coal handling machinery, the architect should decide on several points.

It is objectionable with small plants to discharge the ashes into the conveyor which handles the coal, because the conveyor in that case has to be designed to stand the wear due to handling the ashes, and is more expensive than if designed for coal only.

A type of conveyor considerably cheaper than the pivoted conveyor, which is adapted to handle both coal and ashes in small plants, is made up with "V" shaped cast or malleable buckets operating in cast iron horizontal troughs and provided with proper protection for the chains so that the ash dust does not get onto them.

When necessary to arrange for handling the ashes, it is cheaper to make one conveyor do the work. The only question is, would it not be desirable to have a duplicate device to take the ashes in case of a breakdown?

To carry lump or mine run coal, a large conveyor is used on account of the lumps, and if a small capacity only is required, the cost of installing the machinery is increased over what it would be for screenings only.

The use of a crusher for lump or mine run coal will enable small equipments to take care of the lump coal, but as the crusher must have a large size electric motor or engine to drive it, it becomes a rather expensive adjunct, and need not be installed unless a considerable amount of this coal has to be handled.

The use of high-speed elevators for handling coal straight over the top wheel is objectionable because of the high speed at which the chains must run, and the slow-speed, continuous bucket type, while costing more, will be cheaper in the long run, on account of the excessive cost of repairs. The slow-moving, heavy continuous elevator seldom breaks down.

Where the material runs out of a large hopper, it is desirable to use some automatic feeding device. The reciprocating loaders moving in a horizontal plane, the rotary overshoot wheel type, and the cut-off gate type, operated by the conveyor, are about equally effective.

COAL UNLOADERS.

A large part of the cost of handling coal in the power plants is that of taking the coal out of the ordinary gondola cars and putting it into the conveying machinery.

Very few cars of the bottom dumping type can be obtained, and the dumping devices of these few are frequently out of order, so that the coal has to be shoveled out over the side; therefore it is more satisfactory to unload the coal directly from the car to the boiler room or to the conveyor by power.

The ordinary clam shell bucket equipment will do this, but it removes only about 60% to 75% from the car without shoveling, and the old type buckets frequently injure the cars and the railroad companies oppose their use.

(Continued on Page 257)

SUGGESTIONS FOR THE PROVISIONS OF WIRING AND CABLING OF BUILDINGS FOR TELEPHONE SERVICE.

The extensive use of the telephone at the present time in all classes of buildings, renders it imperative that some provision be made for the large number of wires necessary to provide telephone service.

A pair of wires are necessary for each telephone, and these wires must be carried to some central point in the building. The importance of making adequate provision for this service within the finish of the building is apparent. If some arrangement is not included in the building plans open wire runs will be necessitated, and alterations will have to be made after the completion of the building.

The following is a brief outline of satisfactory schemes of wiring various buildings. This is submitted for the information of Architects and builders.

In general, the wiring of buildings of each class will be uniform. On account of the conditions varying in each building with respect to telephone service, the probable requirements must be estimated as closely as possible. The Telephone Company will be pleased to give their service in advising owners and architects in this connection. With reference to wiring for telephone service, buildings may be divided into general classes.

First: Hotels, hospitals, clubs and apartment houses.

Second: Office buildings, commercial houses and factories.

The characteristics that make a broad distinction between the wiring of these two classes are as follows:

In Class No. 1 a maximum number of telephones in any one room or on any floor is definitely fixed. The whole building may thus be permanently wired.

In Class No. 2 the wiring of buildings for telephone service presents a more difficult problem, for the following reasons:

The number of telephones will depend largely upon the character of the business and district. The number of telephones on any floor of these buildings will depend upon the requirements of the individual tenants. This is not constant for any extended period, as tenants may from time to time be replaced by others using more or less service.

Hotels, Club Houses, Hospitals, Commercial Houses, and Factories.—The telephone system installed in these buildings consists of a telephone switchboard and cross connecting box located at some convenient point, usually on the ground floor in or near the office. The telephones are placed at the desired locations and wired to the cross-connecting box, which is connected by one or more trunk lines with the nearest exchange of the telephone company; thus provision should be made so that the telephone company can run these trunk lines to the above box from the point at which the service cable enters the building. A 2-inch conduit is sufficient for this purpose. One or more distributing boxes are provided on each floor. These boxes should be placed in the walls above the baseboard, and a conduit extended to the cross-connecting box. In hotels, hospitals and clubs the telephone conduit consists of an outlet box placed in each chamber. The present practice is to loop an average of ten outlets and extend a large conduit to the distributing boxes, thus the conduit tapers down to a 1½-inch conduit, at the last outlet. In commercial houses and factories the system of distributing conduits in general is the same as mentioned above. It briefly consists of outlets placed in the baseboard of each or every other column, or of floor boxes placed at 5-foot centers. Distributing boxes should also be provided on the various floors, and conduit installed to the cross-connecting box. This cross-connecting junction box is used for connecting the house cables and service cable with the switchboard. Several 2-inch conduit or cable runways should be installed between the switchboard and cross-connecting box in order to convey the switchboard cables between the above points.

Apartment and Office Buildings.—In apartment buildings the method of wiring is as follows:

One distributing box is established in the basement for every two tiers or six flats. A cable is brought into the building from a vault or pole and extended to the various boxes. A 1½-inch conduit is extended through each tier of flats from the distributing box to the third floor, with an outlet in each flat.

In office buildings the service cable is brought into the building through a sub-duct from the vault in the street or alley and extended to the cross-connecting box, which is located at some convenient place in the basement near the telephone wire shafts. One or more distributing boxes, depending upon the floor area, are established on each floor, at points adjacent to the telephone shafts. From the cross-connecting box cables are extended to and up the shafts to the distributing boxes. The house cables and service cables are terminated in the cross-connecting boxes, so that connections can be made between the two sets of cables.

S. V. W. Architectural Varnishes

No. 1 for Exterior



No. 2 for Interior

FINISHES

G. P. FLOOR FINISH

FOR RUBBED EFFECT:

FLATTINE FLOOR FINISH

FLATTINE CABINET FINISH

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STANDARD VARNISH WORKS

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POINTS ON VARNISH.

BY HERMAN ROSENBERG.

Drying and Hardening.—Proper light and ventilation are absolutely necessary to facilitate drying and hardening. Varnish applied in buildings that are damp and not properly heated in cold weather, will be considerably retarded in drying and hardening. Extremely hot weather will also keep varnish soft for quite a time. The best results are obtained at a temperature of 70 to 75 degrees Fahrenheit.

Turning White.—It is caused by the action of water and dampness. The more elastic the varnish, the better it will resist this action, whereas, cheap, brittle, quick-drying varnishes are very easily affected.

Brittleness.—Is an inherent defect in the varnish caused by an excess of dryer, lack of oil, or by adulterated materials having been used in its manufacture. If a varnish powders white under friction of the finger or easily scratches white, that is incontrovertible evidence of its poor quality. Brittle varnishes should not be used even for the undercoats, as they destroy the toughness and durability of the finish, despite its being protected with an elastic, durable finishing varnish. It is poor economy, in any event, to use brittle varnishes, as the cost of application, which is the main expense, is the same as if good material were employed.

Chilling.—As its name implies, is caused by exposure to cold weather. Varnish should never be used while in this condition. To remedy is to keep the chilled varnish in a warm room, until it has been restored to its normal condition. Long exposure to cold weather may also cause the varnish to become "specky" and "seedy," in which event it is necessary to keep it near a steam pipe or warm stove for some time, until the chilled particles have disappeared.

Cracking.—Cracking is caused by the under coats not having been dry when the finishing coat was applied, or when abnormally heavy coats have been used, especially for the undercoats. Brittle varnishes are liable to crack when exposed to sudden changes of temperature.

Blooming or Going Foggy.—Is caused by exposure to dampness, moisture or gases, after the varnish has become hard. The more elastic the varnish, the less liable it is to "bloom" or become "foggy."

Wrinkling, Crawling, Cramping or Sagging.—Is caused by applying the varnish too heavily or by exposure to sudden changes of temperature while in the process of drying, or if the undercoats are not dry when the finishing coat is applied.

Deadening or Sinking Away.—Caused by the undercoats not having been allowed sufficient time to dry, causing the finishing coat to become absorbed while in the course of hardening. Insufficient foundation coats will also cause the finishing to sink away.

Blistering.—Is caused by the action of heat, especially from the concentrated rays of the sun, if sap or dampness is retained in the wood, or if moisture exists in the undercoats when the finishing coat is applied.

Pitting.—Is caused by applying varnish over an oily or damp surface; also, if the varnisher is not careful to thoroughly incorporate the turpentine in reducing the varnish, or uses improper thinning material.

Knots and Sappy Woods.—The sap and knots should be "killed" by the use of grain or wood alcohol shellac for the first coat. If this is not done, the sap will work through and injure the finish.

Thinning.—When found necessary, should be done with spirits of turpentine. In order to insure proper amalgamation, neither the varnish nor the turpentine should be too cold when mixing. The warmer the varnish and turpentine, the quicker the amalgamation. After reducing the varnish, allow it to stand awhile before using. Oil, Japan or liquid dryer should **never** be added to varnish.

SWEATING.—Is caused by rubbing the undercoat before it is thoroughly dry.

VARNISHES.

Almost everyone knows that Varnish is made from a fossil resin (not rosin), linseed oil and turpentine. Adulterants are rosin and naphtha. Rosin is very cheap and impairs materially the durability of the Varnish of which it is a part; naphtha has no perceptible effect on durability, but merely effects the working properties of the Varnish, and its covering capacity. Of late years a new oil has entered into Varnish making. It is obtained by pressing a certain nut found in China, and it is known as China Wood Oil. This oil has many remarkable properties and many "deviltries," which are partly chargeable to the propensity of the Chinaman to adulterate it, and the difficulty of getting pure oil or detecting the adulteration. This oil costs at present about fifty per cent more than linseed oil, but, if properly and intelligently used, gives results in toughness and durability which make it worth while to use it.

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CHICAGO, ILL.

When Varnish is spoken of, Oil Varnish is almost always meant, but there is a totally distinct kind: spirit Varnish. That means absence of oil. The gum is merely dissolved cold in alcohol or turpentine. The gums used in spirit Varnishes are Shellac, Damar and Sandarac, and when "Shellac" is spoken of, it almost always means Shellac Varnish. So with Damar and Sandarac.

When a spirit Varnish dries there is left on the wood only a thin coating of gum, which is brittle and absolutely unfit for outside exposure, or any place where moisture is likely to reach it. So in bathrooms and kitchens spirit varnish should always be prohibited. Water makes white spots on it which cannot be removed, and a curious fact is that if shellac is used, followed by two or more coats of oil varnish, water will cause spots just as if no oil varnish had been used. Shellac is used as a floor varnish to some extent, the principal advantage being that it dries quickly, and the disadvantage that it spots white.

Damar and Sandarac are used for special purposes. Damar is a soft gum with no virtue except paleness. It is used to mix off with a dark varnish to make it paler, but it never dries hard and has hardly more durability than rosin. Sandarac is used for finishing sounding boards of pianos.

The best varnish, viewed from any standpoint, is made from good copal gum (there are many kinds), linseed oil, or China wood oil, or both, and turpentine. The oil gives life and durability, in proportion to the amount used, but there is a limit to this amount. If too much is used, it will not dry at all, and for places where varnished articles are to be handled, only a small amount can be used. A Varnish for exterior use has a large amount of it, and for interior use on woodwork, furniture or pianos, there is a comparatively small proportion. Piano varnish has least oil and it dries very hard so that it takes a very high polish; quite too hard for ordinary service. Good varnish for trim on houses will last indefinitely. In many places the writer has seen woodwork finished twenty years ago where there is no sign of decay. On front doors and window sills, and on floors, it should have a new coat once a year.

The cost of Varnish used on a building is less than one-eighth of one per cent of the total cost,—the best Varnish. It is so small that it seems hardly worth bothering about, but there is nothing that will show its class so surely in one or two or five years, in preserving or depreciating the appearance of fine wood.

(Continued from Page 252.)

In the more modern grab bucket, the closing path of the jaws is practically horizontal, and the operation by an electrically controlled trolley is simple. Any good laborer can handle such an equipment, and these devices with square-cornered grab buckets will remove about 95%, using one man in the cage only.

The same device will transfer the coal directly to the bunkers over the boilers.

SCREW CONVEYORS.

The spiral or screw conveyor is a very simple device, and can be used for any material which does not stick to the screw and which is not in any sense abrasive, but the screw breaks the material carried and frequently this is an objection. Where grain, cotton seed, sawdust, etc., are to be carried but a short distance the screw is probably the cheapest and most efficient conveyor.

Screw conveyors cannot be used for handling any material in which there are lumps of any size.

Screw conveyors of large diameter, made of cast iron and running at very slow rates of speed may be used for handling ashes for short distances. This device should be arranged to run intermittently.

STEEL CABLE CONVEYORS.

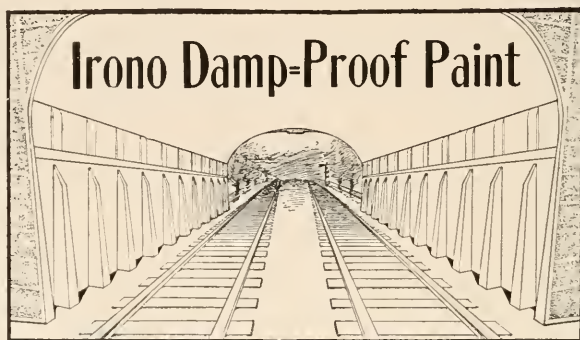
The use of steel cable with discs or flights in various forms for handling all sorts of material is comparatively old, but the conveyors of this type ordinarily give trouble on account of the stretching of the cables and the difficulty of adjusting them to the sprocket wheels at the ends. If, however, this type of conveyor is made up with a steel cable of alternately right and left twisted strands, and the coupling is made by cast iron connections which bolt together at a fixed distance, so that the exact length of the cable can be obtained with certainty, these devices become very satisfactory.

The coupling device and the buttons or contact blocks on the cable, which mesh with the sprocket wheels at the ends, should crimp the cable deeply and fit it accurately, otherwise they will give trouble.

The type of sprocket wheel used for the cable should also be such that a certain amount of stretch in the cable will not cause the blocks to ride on the teeth. An adjustable automatic sprocket is on the market and makes it possible to use cable conveyors up to a length of a thousand feet or more.

Cable conveyors are noisy and they break up the material carried. They are, however, the cheapest form of conveyor where admissible and can frequently be used to advantage.

Irono Damp-Proof Paint



This paint is made especially to meet the requirements for painting any damp surface, such as cellars, underground railways, tunnels, damp walls of dwellings, reinforced cement buildings, etc., where ordinary paint will not adhere.

The wonderful increase of the demand in the building trade for houses finished with stucco (i. e., facing of cement and sand), makes this paint an invention of great value and of popular use in a large way.

You, no doubt, have noticed that these stucco finished walls dry out very patchy, and whereas, oil paint is of no use for that purpose, yet one coat of Irono Damp-Proof will make a good job at a very trivial cost.

It is manufactured in paste form, ready for use when thinned down with about an equal quantity of Benzine. It is strongly adhesive and dries firm and hard a short time after application, and will not peel from a clean surface. It gives a beautiful white flat surface without gloss or shiny streaks, and may be applied on exterior and interior surfaces with a brush or through a painting machine.

It is packed in Barrels containing 700 to 900 pounds, Half Barrels, 100 pound Kegs and 25 pound Pails.

MANUFACTURED ONLY BY

The Muralo Company

CHICAGO BRANCH

24 AND 26 MARKET STREET, CHICAGO, ILL.

A PAINT FOR CEMENT AND STUCCO BUILDINGS.

With the enormous development of cement and stucco buildings has arisen a problem which will have to be met by the paint manufacturer, and that is, the production of paint suitable for use on cement structures. Such a paint will have many requirements to meet which are entirely different from the ordinary conditions existing in the past.

What is needed is a paint which will produce a uniform surface on cement so that these buildings will look even and finished, instead of showing many shades, as is the case with unpainted cement buildings.

The variation in color of cement in these structures is due to many causes—differences in shade of the cement itself—differences in the sand used and those caused by varied proportions—but by far the greatest variations in color are due to amount of water used, the time in setting, weather conditions, and then the filling in and repairing. In order to overcome these variations it will be necessary to give the building a finishing coat of paint.

Ordinary oil paint is very unsatisfactory for many reasons, chiefly because it does not adhere to cement and soon peels away if there is any dampness or moisture in the cement, as there is bound to be. Then again ordinary oil paint gives a glossy, greasy look to the structure which spoils the appearance especially of stucco buildings.

For a great many buildings, especially factory and other large structures, the cold water paints will be used, as they dry out "flat" with the appearance of cement itself and will last for several years, beside being very cheap and easy to apply.

An oil paint to meet the requirements must have some peculiar properties. It must have good covering power. It must dry quickly and a "dead flat." It must be porous enough to allow the moisture to work through it from the inside so that the cement can dry out, and at the same time it must be so compact a covering that it will not allow moisture or water to enter. It must be damp-proof and must be of such a character that it will dry and stick on a wall that is more or less filled with moisture. It must not blister, peel, scale or rub off and should withstand the action of the elements for several years. If it can be applied by machine so much the better. It should be cheap to make it universally used. White and cement color are about the only shades required.

It would seem almost paradoxical that such a paint could be made, yet we have seen a paint which has apparently all the properties above indicated and has withstood the test of time.

One would hardly believe it possible to so combine a paint that it would have sufficient oil to bind it and make a durable surface, and at the same time have it sufficiently porous to allow the moisture to come out, but not go in; at the same time one has but to remember that the conditions are different on the inner and outer side of the paint film, for the water which is back of the film in the cement has a tendency to force its way out into the dry warm air, while the moisture on the outside will have a tendency to either run off or evaporate into the air before it has a chance to go through the paint if it is sufficiently compact and waterproof. On the same principle that the skin allows moisture to pass out through the pores, but is waterproof enough to prevent water entering.

If a paint for cement work has not this peculiar property the paint will blister and peel off because the moisture, being unable to come through, forces the thin impervious skin of paint off and this has been the trouble with all paints heretofore used on cement and stucco structures.

JNO. J. WHEELER.
PRESIDENT AND TREASURER.

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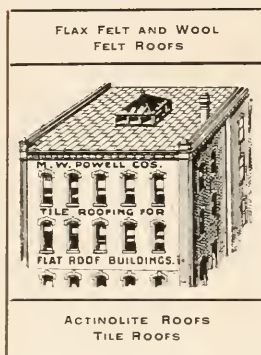
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GRAVEL ROOFING.

Appended are three specifications for good work:

Five (5) Ply Wool Felt, Composition and Gravel Roof.

First cover the sheathing boards with one (1) layer of dry felt and over this put four (4) thicknesses of wool roofing felt, weighing not less than fifteen (15) pounds (single thickness) to the square of one hundred (100) feet. This felt to be smoothly and evenly laid and well cemented together the full width of the lap, not less than nine (9) inches between each layer, with best roofing cement, using not less than one hundred (100) pounds of roofing cement to the square of one hundred (100) feet. All joinings along walls and around openings to be carefully made. The roof to be then covered with a heavy coating of roofing cement and screened gravel, not less than one (1) cubic yard of gravel to six hundred (600) square feet, gravel to be screened through $\frac{5}{8}$ -inch mesh and free from sand and loam. All walls and openings to be flashed. If not, the rear end of the walls to be flashed not less than fifteen (15) feet from the gutter on each side.

Six (6) Ply Cap Sheet Wool Felt, Composition and Gravel Roof.

First cover the sheathing boards with one (1) layer of dry felt and over this put four (4) thicknesses of wool roofing felt, weighing not less than fifteen (15) pounds (single thickness) to the square of one hundred (100) feet. This felt to be smoothly and evenly laid and well cemented together the full width of the lap, not less than nine (9) inches between each layer, with best roofing cement, using not less than one hundred and twenty (120) pounds of roofing cement to the square of one hundred (100) feet. The entire surface then to be mopped over with roofing cement and a cap sheet of wool felt applied. All joinings along the walls and around the openings to be carefully made. The roof to be then covered with a heavy coating of roofing cement and screened gravel, not less than one (1) cubic yard of gravel to six hundred (600) square feet, gravel to be screened through $\frac{5}{8}$ -inch mesh and free from sand and loam. All walls and openings to be flashed. If not, the rear end of the walls to be flashed not less than fifteen (15) feet from the gutter on each side.

Six (6) Combined Flax and Wool Felt, Composition and Gravel Roof.

First cover the sheathing boards with one (1) layer of dry felt and over this put one (1) layer of flax felt and three thicknesses of wool roofing felt, weighing not less than fifteen (15) pounds (single thickness) to the square of one hundred (100) feet. This felt to be smoothly and evenly laid and well cemented together the full width of the lap, not less than eleven (11) inches between each layer, with best roofing cement, using not less than one hundred and twenty (120) pounds of roofing cement to the square of one hundred (100) feet. The entire surface then to be mopped over with roofing cement and a cap sheet of wool felt applied. All joinings along walls and around openings to be carefully made. The roof to be then covered with a heavy coating of roofing cement and screened gravel, not less than one (1) cubic yard of gravel to six hundred (600) square feet, gravel to be screened through $\frac{5}{8}$ -inch mesh and free from sand and loam. All walls and openings to be flashed. If not, the rear end of the walls to be flashed not less than fifteen (15) feet from the gutter on each side.

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THE MAXWELL TRUSSED BAR

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A HIGH TENSION WEB with a **MECHANICAL BOND**.

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The whitest enamel on the market. Stays white and is not affected by gases, and dries with a high gloss. It will rub perfectly in 48 hours. Does not work tacky under the brush and can be brushed over a number of times before setting up, so as to leave a perfect finish. Works fast and dries perfectly.

A trial will more than please you.

STA-WHITE BODY

Is the best undercoat or Flat White ever produced. Covers better than any Zinc or Lead and Zinc Combination. Is White and will stay White. Write for specifications.

Royal Crown Lead Co.

562-564 CLAY AVE.

DETROIT, MICH.

Useful Notes.

Roof boards weigh about three pounds per superficial foot.

Terra cotta tiling weighs from 25 to 35 pounds per square foot.

Hollow tile for five-inch partition weighs from 22 to 35 pounds per superficial foot.

Lath and plastering, two-coat work, weighs from 9 to 12 pounds per superficial foot.

The weight of a superficial foot of brickwork eight inches thick, including mortar, is from 83 to 87 pounds.

An iron roof 100 feet wide, with a rise of one-third pitch, will weigh from 10 to 15 pounds per superficial foot.

One hundred pounds per square foot distributed uniformly over a surface of a bridge is a safe working standard.

The weight per square foot of roof tiling, set in iron or between wood rafters ready for slating, is about 12 pounds.

A fireproof floor constructed of iron beams and four-inch brick arches will weigh from 65 to 75 pounds per superficial foot.

The safe and proper bearing of joist, timber and girders supporting a floor should not exceed ten tons on brick walls and fourteen tons on good stone walls.

A fireproof floor constructed of iron beams and of iron arches made of No. 18 iron, and filled in on top with concrete or slag and cement, will weigh about the same as brickwork four inches thick.

Smallest convenient size of slab for a 14-inch washbowl, 21 by 24 inches. Height of slab from floor, 2 feet 6 inches. Very small (12) inch corner washbowl: slab 1 foot 11 inches each side.

Space occupied by water closets, 2 feet 6 inches wide, 2 feet deep.

Urinals should be not less than 2 feet 2 inches between partitions; partitions 6 feet high.

Horse Stalls.—Width, 3 feet 10 inches to 4 feet, or over 5 feet in width and 9 feet long. Width should not be between 4 and 5 feet, as in such cases the horse is liable to cast himself.

Pitch of Tin, Copper or Tar and Gravel Roof.—Three-eighths of an inch to the foot and upward.

A load of mortar measures a cubic yard, requires a cubic yard of sand and nine bushels of lime, and will fill thirty hods.

A bricklayer's hod measuring one foot four inches by nine inches, equals 1,296 cubic inches in capacity, and contains twenty bricks.

A single load of sand or other materials equals a cubic yard.

One thousand bricks closely stacked occupy about fifty-six cubic feet.

One thousand old bricks cleaned and loosely stacked occupy, about seventy-two cubic feet.

One hundred yards of plastering will require fourteen hundred faths, four and a half bushels of lime, four-fifths of a load of sand, nine pounds of hair and five pounds of nails, for two-coat work.

A bushel of hair weighs, when dry, about fifteen pounds.

Flashings.—By "flashings" are meant pieces of tin, zinc or copper laid over slate, and up against wall, chimneys, copings, etc.

Counter flashings are of lead or zinc, and are solid between the courses in brick, and turned down over the flashings.

In flashing against stonework, grooves should be cut to receive the counter flashing.

VELOCITY OF WIND.

FILE 389.

10 miles, per square foot,	0.49 lbs.	50 miles, per square foot,	12.304 lbs.
20 miles, per square foot,	1.97 lbs.	60 miles, per square foot,	17.733 lbs.
30 miles, per square foot,	4.43 lbs.	70 miles, per square foot,	24.153 lbs.
40 miles, per square foot,	7.87 lbs.	100 miles, per square foot,	49.200 lbs.

LIQUID MEASURE.

31½ gallons = 1 barrel.	2 pints = 1 quart = 67.2 c. inches.
2 barrels = 1 hoghead.	4 quarts = 1 gallon = 268.8 c. inches.
1 barrel = 4½ cubic feet.	1 gallon U. S. = 8.34 lb.
8.665 cubic inches = 1 gill.	1 gallon U. S. = 231 cubic inches.
4 gills = 1 pint = 33.6 c. inches.	1 cubic foot = 7.48 U. S. gallons.

DRY MEASURE.

1 barrel pork = 200 pounds.	8 gallons = 1 bushel.
1 barrel fish = 200 pounds.	64 gallons = 1 quarter.
1 barrel flour = 196 pounds.	1 bushel = 1.28 cubic feet.
1 barrel salt = 280 pounds.	1 cubic foot corn = 42 pounds.
1 barrel beef = 200 pounds.	1 cubic foot rice = 48 pounds.
1 bushel corn = 56 pounds.	1 cubic foot hops = 27 pounds.
1 bushel oats = 30 to 33½ pounds.	1 carload = 680 bushels.
1 bushel wheat = 60 pounds.	1 c. foot Anthr. coal = 54 lbs.
1 bushel potatoes = 60 pounds.	1 ton Anthr. coal = abt. 40 c. ft.
2 gallons = 1 peck.	

PAPER.

24 sheets = 1 quire.	21½ quires = 1 ream printers'.
20 sheets = 1 quire outsides.	2 reams = 1 bundle.
25 sheets = 1 quire printers.	10 reams = 1 bale.
20 quires = 1 ream.	60 skins = 1 roll of parchement.

WEIGHTS AND MEASURES—LINEAL MEASURE.

2¼ inches = 1 nail.	4 poles or 22 yards = 1 chain.
4 inches = 1 hand.	220 yards or 40 poles = 1 furlong.
3 inches = 1 palm.	1760 yards or 8 furlongs = 1 mile.
9 inches = 1 span.	7.92 inches = 1 link.
12 inches = 1 foot.	100 links or 66 ft. = 1 chain.
45 inches = 1 ell.	10 chains = 1 furlong.
3 feet = 1 yard.	80 chains = 1 mile.
6 feet = 1 fathom.	3 miles = 1 league.
16½ feet or 5½ yards = 1 rod, pole, or perch.	240 yards = 1 cable length.
	6086.07 feet = 1 knot or sea mile.

LENGTH OF A FOOT IN DIFFERENT COUNTRIES.

	Inches.		Inches.
Spain	11.03	Denmark	12.35
Holland	11.14	Prussia	12.36
Sweden	11.14	Austria	12.45
America	12	Portugal	12.96
England	12	Russia	13.75

LENGTH OF A MILE IN DIFFERENT COUNTRIES.

	Am. yards.		Am. yards.
Russian	1,100	Spanish	5.028
Italian	1,467	German	5.866
English	1,760	Swedish and Danish.....	7,233
American	1,760	Hungarian	8,630
Scotch	1,984	Norwegian	12,400
Irish	2,200	French league	3,666
Polish	4,400		

SQUARE MEASURE.

144 square inches = 1 square foot.
 9 square feet = 1 square yard.
 $272\frac{1}{2}$ feet = 1 square rod or pole.
 40 rods = 1 square rood.
 4 rods }
 160 rods }
 4,840 yards. } = 1 acre.
 43,560 feet }
 10 square chains }
 640 acres = 1 square mile.

2,471 acres = 1 hectare.
 7,840 square yards = 1 Irish acre.
 6150 square yards = 1 Scotch acre.
 30 square acres = 1 yard of land.
 100 acres = 1 hide of land.
 40 hides = 1 barony.
 36 sq. miles = 1 township.
 640 acres = 1 section.
 About 14 25x125 ft. lots = 1 acre.

SOLID OR CUBIC MEASURE.

1728 cubic inches = 1 cubic foot.
 27 cubic feet = 1 cubic yard.
 40 cubic feet of rough or 50 cubic feet
 of hewn timber = 1 ton or load.

108 cubic feet = 1 stack of wood.
 128 cubic feet = 1 cord of wood.
 40 c. ft. = 1 U. S. A. shipping ton.
 42 c. ft. = 1 British shipping ton.

AVOIRDUPOIS WEIGHT.

16 drachms = 1 ounce.
 16 ounces = 1 pound.
 28 pounds = 1 quarter.

112 pounds = 1 cwt.
 20 cwt. = 1 ton.

TROY WEIGHT.

24 grains = 1 dwt.
 20 dwt. = 1 oz.

12 oz. = 1 lb.

SIZES OF PAPER (Whatman's).

	Inches.		Inches.
Emperor	72 x 48	Royal	24 x 19
Antiquarian	53 x 31	Medium	22 x $17\frac{1}{2}$
Double elephant	40 x $26\frac{3}{4}$	Demy	20 x $15\frac{1}{2}$
Atlas	34 x 26	Large post	$20\frac{3}{4}$ x $16\frac{3}{4}$
Colombier	$34\frac{1}{2}$ x $23\frac{1}{2}$	Post	19 x $15\frac{1}{4}$
Imperial	30 x 22	Foolscap	17 x $13\frac{1}{2}$
Elephant	28 x 23	Post	15 x $12\frac{1}{2}$
Super royal	27 x 19	Copy	20 x 16

Water.

1 cubic foot of water equals 62.5 pounds, or 7.48 U. S. gallons.
 1 cubic inch of water equals .036 pounds.
 1 cubic foot of water equals 6.2355 Imp. gallons or 7.48 U. S. gallons.
 1 cylindrical foot of water equals 49.1 pounds or 5.89 U. S. gallons.
 1 U. S. gallon of water equals 8.34 pounds.
 1 U. S. gallon of water equals 231 cubic inches.
 1 pound pressure per square inch is equivalent to a head of water of 2.3093 feet;
 1 pound—27.71 inches; 14.7 pounds or 1 atmosphere—33.947 feet, or 10.347
 metres; 0.433 pound or 1 atmosphere—1 foot; 43.3 pounds—100 feet.

Gauges and Their Equivalents.

No. 27, equal to $\frac{1}{64}$ inch.
 " 21, " " $\frac{3}{32}$ "
 " 18, " " $\frac{3}{16}$ "
 " 16, " " $\frac{1}{8}$ "
 " 14, " " $\frac{5}{64}$ "
 " 13, " " $\frac{3}{32}$ "

No. 12, equal to $\frac{7}{64}$ inch.
 " 10, " " $\frac{1}{8}$ "
 " 8, " " $\frac{3}{16}$ "
 " 6, " " $\frac{3}{8}$ "
 " 5, " " $\frac{1}{2}$ "
 " 4, " " 1 "

Metric Tables.

	Approximate. Equivalent		Accurate. Equivalent
1 inch	[length].. $2\frac{1}{2}$	cubic centimeters	2.539
1 centimeter	0.4	inch	0.393
1 yard	1	meter	0.914
1 meter (39.37 inches).....	1	yard	1.093
1 foot	30	centimeters	30.479
1 kilometer (1,000 meters).....	$\frac{5}{8}$	mile	0.621
1 mile	$1\frac{1}{2}$	kilometers	1.600
1 gramme	[weight].. $15\frac{1}{2}$	grains	15.432
1 grain.....	0.064	gramme	0.064
1 kilogramme (1,000 grammes).....	2.2	pounds avoirdupois.....	2.204
1 pound avoirdupois	$\frac{1}{2}$	kilogramme	0.453
1 ounce avoirdupois ($437\frac{1}{2}$ grains).....	$28\frac{1}{2}$	grammes	28.349
1 ounce troy, or apothecary (480 grains)..<	31	grammes	31.103
1 cubic centimeter	[bulk].. 1.06	cubic inch	1.060
1 cubic inch.....	$16\frac{1}{2}$	cubic centimeters	16.386
1 liter (1,000 cubic centimeters).....	1	U. S. standard quart.....	0.946
1 United States quart.....	1	liter	1.057
1 fluid ounce.....	$29\frac{1}{2}$	cubic centimeters	29.570
1 hectare (10,000 square meters) [surface]	$2\frac{1}{2}$	acres	2.471
1 acre	0.4	hectare	0.40

In the nickel five-cent piece of our coinage is a key to the tables of linear measures and weights. The diameter of this coin is two centimeters, and its weight is five grammes. Five of them placed in a row will give the length of the decimeter, and two of them will weigh a decagram. As the kiloliter is a cubic meter, the key to the measure of length is also the key to the measure of capacity.

Handy Table.

FILE 511.B

Diameter of a circle $\times 3.1416$ = circumference.
 Radius of a circle $\times 6.283185$ = circumference.
 Square of the diameter of a circle $\times 0.7854$ = area.
 Square of the circumference of a circle $\times 0.07958$ = area.
 Half the circumference of a circle \times half its diameter = area.
 Circumference of a circle $\times 0.159155$ = radius.
 Square root of the area of a circle $+ 0.56419$ = radius.
 Circumference of a circle $\times 0.31831$ = diameter.
 Square root of the area of a circle $\times 1.12838$ = diameter.
 Diameter of a circle $\times 0.86$ = side of inscribed equilateral triangle.
 Diameter of a circle $\times 0.7071$ = side of an inscribed square.
 Circumference of a circle $+ 0.225$ = side of an inscribed square.
 Circumference of a circle $\times 0.282$ = side of an equal square.
 Diameter of a circle $\times 0.8862$ = side of an equal square.
 Base of a triangle $\times \frac{1}{2}$ the altitude = area.
 Multiplying both diameters and .7854 together = area of an ellipse.
 Surface of a sphere $\times \frac{1}{6}$ of its diameter = solidity.
 Circumference of a sphere \times its diameter = surface.
 Square of the diameter of a sphere $\times 3.1416$ = surface.
 Square of the circumference of a sphere $\times 0.3183$ = surface.
 Cube of the diameter of a sphere $\times 0.5236$ = solidity.
 Cube of the radius of a sphere $\times 4.1888$ = solidity.
 Cube of the circumference of a sphere $\times 0.016887$ = solidity.
 Square root of the surface of a sphere $\times 0.56419$ = diameter.
 Square root of the surface of a sphere $+ 1.772454$ = circumference.
 Cube root of the solidity of a sphere $\times 1.2407$ = diameter.
 Cube root of the solidity of a sphere $\times 3.8978$ = circumference.
 Radius of a sphere $\times 1.1547$ = side of inscribed cube.

Square root of ($\frac{1}{3}$ of the square of) the diameter of a sphere = side of inscribed cube.
 Area of its base $\times \frac{1}{3}$ of its altitude = solidity of a cone or pyramid, whether round, square, or triangular.
 Area of one of its sides $\times 6$ = surface of a cube.
 Altitude of trapezoid $\times \frac{1}{2}$ the sum of its parallel sides = area.

TABLE OF SQUARE ROOTS.

FILE 511.9

No.	Sq. Root.	No.	Sq. Root.	No.	Sq. Root.	No.	Sq. Root
25	5.	650	25.46	1400	37.42	2600	50.99
50	7.071	700	26.46	1450	38.08	2700	51.96
75	8.66	750	27.39	1500	38.73	2800	52.91
100	10.00	800	28.28	1550	39.37	2900	53.85
125	11.18	850	29.15	1600	40.00	3000	54.77
150	12.25	900	30.00	1650	40.62	3200	56.57
175	13.23	950	30.82	1700	41.23	3400	58.30
200	14.14	1000	31.62	1800	42.43	3600	60.00
250	15.81	1050	32.40	1900	43.59	3800	61.64
300	17.32	1100	33.16	2000	44.72	4000	63.24
350	18.70	1150	33.91	2100	45.82	4200	64.80
400	20.00	1200	34.64	2200	46.90	4400	66.32
450	21.21	1250	35.36	2300	47.95	4600	67.82
500	22.36	1300	36.06	2400	48.99	4800	69.28
550	23.45	1350	36.74	2500	50.00	5000	70.72
600	24.49						

Dimensions of a Barrel.—Diameter of head, 17 inches; bung, 19 inches; length, 28 inches; volume, 7,680 cubic inches.

Expansion of Water (Dalton).

FILE 532

Temperature.	Expansion.	Temperature.	Expansion.	Temperature.	Expansion.
22°	1.0009	72°	1.0018	152°	1.01934
32	1	92	1.00477	172	1.02575
*46	1	112	1.0088	192	1.03265
52	1.00021	132	1.01367	212	1.0466

*Greatest density at 39.1° Fahr.

A box 24 inches long by 16 inches wide and 28 inches deep will contain a barrel, or three bushels; 24 by 16 inches and 14 inches deep contains half a barrel; 16 inches square and 8 $\frac{1}{2}$ inches deep will contain one bushel; 16 by 8 $\frac{1}{2}$ inches and 8 inches deep will contain half a bushel; 8 by 8 $\frac{1}{2}$ inches and 8 inches deep will contain one peck; 8 inches square and 4 $\frac{1}{2}$ inches deep will contain one gallon; 7 by 4 inches and 4 $\frac{1}{2}$ inches deep will contain half a gallon; 4 inches square and 4 $\frac{1}{2}$ inches deep will contain one quart; 4 feet long, 3 feet 5 inches wide and 2 feet 8 inches deep will contain one ton of coal, or 36 cubic feet.

FILE 532.24

Table Showing the Pressure of Water at Different Elevations.

Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch.
1	43	65	28.15	130	56.31	195	84.47	260	112.62	350	151.61
5	2 16	70	30.32	135	58.48	200	86.63	265	114.79	360	155.94
10	4 33	75	32.48	140	60.64	205	88.80	270	116.96	370	160.27
15	6 49	80	34.65	145	62.81	210	90.96	275	119.12	380	164.61
20	8 66	85	36.82	150	64.97	215	93.14	280	121.29	390	168.94
25	10 82	90	38.98	155	67.14	220	95.30	285	123.45	400	173.27
30	12 99	95	41.15	160	69.31	225	97.49	290	125.62	500	216.58
35	15 16	100	43.31	165	71.47	230	99.63	295	127.78	600	259.90
40	17 32	105	45.48	170	73.64	235	101.79	300	129.95	700	303.22
45	19 49	110	47.64	175	75.80	240	103.96	310	134.28	800	346.4
50	21.65	115	49.81	180	77.97	245	106.13	320	138.62	900	389.86
55	23.82	120	51.98	185	80.14	250	108.29	330	142.95	1,000	433.18
60	25 99	125	54.15	190	82.30	255	110.46	340	147.28		

TABLES OF SAFE LOADS FOR RECTANGULAR AND CYLINDRICAL COLUMNS.

FILE 620.12

Safe Loads in Tons of 2,000 Lbs. for Hollow Rectangular Cast Iron Columns.

Section Length in Feet	6 x 8 INCHES.																8 x 12 INCHES.																8 x 16 INCHES.																8 x 20 INCHES.																Section Length in Feet																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/4	1 7/8	2	2 1/4	2 3/4	3	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/4	1 7/8	2	2 1/4	2 3/4	3	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/4	1 7/8	2	2 1/4	2 3/4	3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
6	73	83	90	100	108	113	118	123	128	133	138	143	148	153	158	163	168	173	178	183	188	193	198	203	208	213	218	223	228	233	238	243	248	253	258	263	268	273	278	283	288	293	298	303	308	313	318	323	328	333	338	343	348	353	358	363	368	373	378	383	388	393	398	403	408	413	418	423	428	433	438	443	448	453	458	463	468	473	478	483	488	493	498	503	508	513	518	523	528	533	538	543	548	553	558	563	568	573	578	583	588	593	598	603	608	613	618	623	628	633	638	643	648	653	658	663	668	673	678	683	688	693	698	703	708	713	718	723	728	733	738	743	748	753	758	763	768	773	778	783	788	793	798	803	808	813	818	823	828	833	838	843	848	853	858	863	868	873	878	883	888	893	898	903	908	913	918	923	928	933	938	943	948	953	958	963	968	973	978	983	988	993	998	1003	1008	1013	1018	1023	1028	1033	1038	1043	1048	1053	1058	1063	1068	1073	1078	1083	1088	1093	1098	1103	1108	1113	1118	1123	1128	1133	1138	1143	1148	1153	1158	1163	1168	1173	1178	1183	1188	1193	1198	1203	1208	1213	1218	1223	1228	1233	1238	1243	1248	1253	1258	1263	1268	1273	1278	1283	1288	1293	1298	1303	1308	1313	1318	1323	1328	1333	1338	1343	1348	1353	1358	1363	1368	1373	1378	1383	1388	1393	1398	1403	1408	1413	1418	1423	1428	1433	1438	1443	1448	1453	1458	1463	1468	1473	1478	1483	1488	1493	1498	1503	1508	1513	1518	1523	1528	1533	1538	1543	1548	1553	1558	1563	1568	1573	1578	1583	1588	1593	1598	1603	1608	1613	1618	1623	1628	1633	1638	1643	1648	1653	1658	1663	1668	1673	1678	1683	1688	1693	1698	1703	1708	1713	1718	1723	1728	1733	1738	1743	1748	1753	1758	1763	1768	1773	1778	1783	1788	1793	1798	1803	1808	1813	1818	1823	1828	1833	1838	1843	1848	1853	1858	1863	1868	1873	1878	1883	1888	1893	1898	1903	1908	1913	1918	1923	1928	1933	1938	1943	1948	1953	1958	1963	1968	1973	1978	1983	1988	1993	1998	2003	2008	2013	2018	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2073	2078	2083	2088	2093	2098	2103	2108	2113	2118	2123	2128	2133	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	2188	2193	2198	2203	2208	2213	2218	2223	2228	2233	2238	2243	2248	2253	2258	2263	2268	2273	2278	2283	2288	2293	2298	2303	2308	2313	2318	2323	2328	2333	2338	2343	2348	2353	2358	2363	2368	2373	2378	2383	2388	2393	2398	2403	2408	2413	2418	2423	2428	2433	2438	2443	2448	2453	2458	2463	2468	2473	2478	2483	2488	2493	2498	2503	2508	2513	2518	2523	2528	2533	2538	2543	2548	2553	2558	2563	2568	2573	2578	2583	2588	2593	2598	2603	2608	2613	2618	2623	2628	2633	2638	2643	2648	2653	2658	2663	2668	2673	2678	2683	2688	2693	2698	2703	2708	2713	2718	2723	2728	2733	2738	2743	2748	2753	2758	2763	2768	2773	2778	2783	2788	2793	2798	2803	2808	2813	2818	2823	2828	2833	2838	2843	2848	2853	2858	2863	2868	2873	2878	2883	2888	2893	2898	2903	2908	2913	2918	2923	2928	2933	2938	2943	2948	2953	2958	2963	2968	2973	2978	2983	2988	2993	2998	3003	3008	3013	3018	3023	3028	3033	3038	3043	3048	3053	3058	3063	3068	3073	3078	3083	3088	3093	3098	3103	3108	3113	3118	3123	3128	3133	3138	3143	3148	3153	3158	3163	3168	3173	3178	3183	3188	3193	3198	3203	3208	3213	3218	3223	3228	3233	3238	3243	3248	3253	3258	3263	3268	3273	3278	3283	3288	3293	3298	3303	3308	3313	3318	3323	3328	3333	3338	3343	3348	3353	3358	3363	3368	3373	3378	3383	3388	3393	3398	3403	3408	3413	3418	3423	3428	3433	3438	3443	3448	3453	3458	3463	3468	3473	3478	3483	3488	3493	3498	3503	3508	3513	3518	3523	3528	3533	3538	3543	3548	3553	3558	3563	3568	3573	3578	3583	3588	3593	3598	3603	3608	3613	3618	3623	3628	3633	3638	3643	3648	3653	3658	3663	3668	3673	3678	3683	3688	3693	3698	3703	3708	3713	3718	3723	3728	3733	3738	3743	3748	3753	3758	3763	3768	3773	3778	3783	3788	3793	3798	3803	3808	3813	3818	3823	3828	3833	3838	3843	3848	3853	3858	3863	3868	3873	3878	3883	3888	3893	3898	3903	3908	3913	3918	3923	3928	3933	3938	3943	3948	3953	3958	3963	3968	3973	3978	3983	3988	3993	3998	4003	4008	4013	4018	4023	4028	4033	4038	4043	4048	4053	4058	4063	4068	4073	4078	4083	4088	4093	4098	4103	4108	4113	4118	4123	4128	4133	4138	4143	4148	4153	4158	4163	4168	4173	4178	4183	4188	4193	4198	4203	4208	4213	4218	4223	4228	4233	4238	4243	4248	4253	4258	4263	4268	4273	4278	4283	4288	4293	4298	4303	4308	4313	4318	4323	4328	4333	4338	4343	4348	4353	4358	4363	4368	4373	4378	4383	4388	4393	4398	4403	4408	4413	4418	4423	4428	4433	4438	4443	4448	4453	4458	4463	4468	4473	4478	4483	4488	4493	4498	4503	4508	4513	4518	4523	4528	4533	4538	4543	4548	4553	4558	4563	4568	4573	4578	4583	4588	4593	4598	4603	4608	4613	4618	4623	4628	4633	4638	4643	4648	4653	4658	4663	4668	4673	4678	4683	4688	4693	4698	4703	4708	4713	4718	4723	4728	4733	4738	4743	4748	4753	4758	4763	4768	4773	4778	4783	4788	4793	4798	4803	4808	4813	4818	4823	4828	4833	4838	4843	4848	4853	4858	4863	4868	4873	4878	4883	4888	4893	4898	4903	4908	4913	4918	4923	4928	4933	4938	4943	4948	4953	4958	4963	4968	4973	4978	4983	4988	4993	4998	5003	5008	5013	5018	5023	5028	5033	5038	5043	5048	5053	5058	5063	5068	5073	5078	5083	5088	5093	5098	5103	5108	5113	5118	5123	5128	5133	5138	5143	5148	5153	5158	5163	5168	5173	5178	5183	5188	5193	5198	5203	5208	5213	5218	5223	5228	5233	5238	5243	5248	5253	5258	5263	5268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Chicago Municipal Code, Sec. 593.—No cast iron column shall have a length to exceed 24 times its diameter or least side.

Safe Loads in Tons of 2,000 Lbs. for Hollow Cylindrical Cast Iron Columns.

[illegible]

I.—The diameter of the driver and driven being given, to find the number of revolutions of the driven:

Rule.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the diameter of the driven; the quotient will be the number of revolutions.

II.—The diameter and the revolutions of the driver being given, to find the diameter of the driven, that shall make any given number of revolutions in the same time:

Rule.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the number of revolutions of the driven; the quotient will be its diameter.

III.—To ascertain the size of the driver:

Rule.—Multiply the diameter of the driven by the number of revolutions you wish to make, and divide the product by the revolutions of the driver; the quotient will be the size of the driver.

Belts.

FILE 621.852

Leather belts must be well protected against water, and even moisture.

India-rubber is the proper substance for belts exposed to the weather.

It is desirable to run the grain (hair) side of leather belts on the pulley, in order that the strongest part of the belt may be subject to the least wear.

Leather belts run with grain side to the pulley will drive thirty per cent more than if run with flesh side. The belt, as well as the pulley, adheres best when smooth, and the grain side adheres best because it is smoothest.

The transmitting power of a double belt is to that of single belt as 10 is to 7. In ordering pulleys, the kind of belt to be used should always be specified.

Belts should be kept soft and pliable. For this purpose blood-warm tallow, dried in by heat of fire or the sun, is advised. Castor-oil dressing is also good.

The motion of driving should run *with* and not *against* the laps of the belts.

If too great a distance is attempted, the weight of the belt will produce a very heavy sag, drawing so hard on the shaft as to produce great friction in the bearings, while at the same time the belt will have an unsteady, flapping motion, which will destroy both the belt and machinery.

If possible to avoid it, connected shafts should never be placed one directly over the other, as in such case the belt must be kept very tight to do the work. For this purpose belts should be carefully selected of *well-stretched* leather.

It is desirable that the angle of the belt with the floor should not exceed 45 degrees. It is also desirable to locate the shafting and machinery so that belts should run off from each shaft in opposite directions, as this arrangement will relieve the bearings from the friction that would result when the belts all pull one way on the shaft.

The diameter of the pulleys should be as large as can be admitted.

The pulley should be a little wider than the belt required for the work.

When it is not convenient to measure with the tape line the length required, apply the following rule: Add the diameter of the two pulleys together, divide the result by 2, and multiply the quotient by $3\frac{1}{4}$, then add this product to twice the distance between the centers of the shafts, and you have the length required.

The width of belt needed depends on three conditions: 1. The tension of the belt. 2. The size of the smaller pulley, and the proportion of the surface touched by the belt. 3. The speed of the belt.

The working adhesion of a belt to the pulley will be in proportion both to the number of square inches of belt contact with the surface of the pulley and also to the arc of the circumference of the pulley touched by the belt. This adhesion forms the basis of all right calculation in ascertaining the width of belt necessary to transmit a given horse-power.

Capacity of Cisterns.

FILE 628.13

For a circular cistern, square the diameter and multiply by .7854, for the area; multiply this by 1.728 and divide by 231, for number of gallons of one foot in depth; for a square cistern, multiply length by breadth, and proceed as above.

CIRCULAR CISTERN.

5 feet in diameter holds 4.66 bbls.
 6 feet in diameter holds 6.71 bbls.
 7 feet in diameter holds 9.13 bbls.
 8 feet in diameter holds 11.93 bbls.
 9 feet in diameter holds 15.10 bbls.
 10 feet in diameter holds 18.65 bbls.

SQUARE CISTERN.

5 feet by 5 feet holds 5.92 bbls.
 6 feet by 6 feet holds 8.54 bbls.
 7 feet by 7 feet holds 11.63 bbls.
 8 feet by 8 feet holds 15.19 bbls.
 9 feet by 9 feet holds 19.39 bbls.
 10 feet by 10 feet holds 23.74 bbls.

FILE 628.15

Wrought-iron Welded Pipe.

DIMENSIONS, WEIGHTS, ETC., OF STANDARD SIZES FOR STEAM, GAS, WATER, OIL, ETC.

Inside Diameter	Outside Diameter	External Circumference, A	Length of Pipe per Sq Foot of Outside Surface.	Internal Area	External Area	Length of Pipe containing one Cubic Foot.	Weight per Foot of Length	No. of Threads per Inch of Screw.	Contents in *Gallons per Foot.	Weight of Water per Foot of Length.
In.	In	In.	Ft.	In.	In	Ft	Lbs.			Lbs.
1/8	.40	1.272	9.44	.012	.129	2,500	.24	27	.0006	.005
1/4	.54	1.656	7.075	.049	.229	1,355	.42	18	.0026	.021
3/8	.67	2.121	5.657	.110	.358	751.5	.56	14	.0057	.047
1/2	.84	2.652	4.502	.196	.554	472.4	.84	14	.0102	.085
3/4	1.05	3.299	3.637	.441	.866	270.	1.12	11 1/2	.0230	.190
1	1.31	4.134	2.993	.785	1.357	166.9	1.67	11 1/2	.0408	.349
1 1/4	1.66	5.215	2.301	1.227	2.104	96.25	2.25	11 1/2	.0638	.527
1 1/2	1.9	5.969	2.01	1.767	2.535	70.65	2.69	11 1/2	.0918	.760
2	2.37	7.461	1.611	3.141	4.330	42.36	3.66	8	.1632	1.356
2 1/2	2.87	9.032	1.328	4.908	6.491	30.11	5.77	8	.2550	2.116
3	3.5	10.996	1.061	7.068	9.621	19.49	7.54	8	.3673	3.049
3 1/2	4	12.566	.955	9.621	12.566	14.56	9.05	8	.4993	4.155
4	4.5	14.137	.810	12.566	15.904	11.31	10.72	8	.6523	5.405
4 1/2	5	15.708	.705	15.904	19.635	9.03	12.49	8	.8263	6.851
5	5.56	17.475	.629	19.635	24.299	7.20	14.56	8	1.020	8.500
5 1/2	6.62	20.813	.577	28.274	34.471	4.95	15.76	8	1.469	12.312
6	7.62	23.954	.505	38.484	45.663	3.72	23.41	8	1.999	16.662
6 1/2	8.62	27.096	.444	50.265	58.426	2.85	28.34	8	2.611	21.750
7	9.65	30.433	.394	63.617	73.715	2.26	34.67	8	3.300	27.500
8	10.75	33.772	.355	78.540	90.792	1.80	40.64	8	4.051	34.000

* The Standard U. S. gallon of 231 inches.

Multiply the external circumference column, A, by 12 and the result will be the square feet of surface per lineal foot

FILE 528.24

Quantity of Brickwork in Barrel Drains and Wells.

Diameter in Clear	Thickness of Brickwork	Superficial Feet of Brickwork in One Linear Yard.	Number of Bricks Required for One Linear Yard
1 foot, 0 inches	0 feet, 4 1/2 inches	16 feet, 6 inches	115
1 " 6 "	0 " 4 1/2 "	21 " 2 "	148
2 " 0 "	0 " 4 1/2 "	25 " 10 "	181
2 " 6 "	0 " 9 "	33 " 0 "	462
2 " 6 "	0 " 9 "	37 " 8 "	528
2 " 6 "	1 " 1 "	43 " 2 "	906
3 " 0 "	0 " 9 "	42 " 6 "	594
3 " 0 "	1 " 1 "	47 " 10 "	1004
3 " 6 "	0 " 9 "	47 " 1 "	659
3 " 6 "	1 " 1 "	52 " 7 "	1104
4 " 0 "	0 " 9 "	51 " 10 "	725
4 " 0 "	1 " 1 "	57 " 3 "	1203
5 " 0 "	0 " 9 "	61 " 3 "	857
5 " 0 "	1 " 1 "	66 " 9 "	1402
6 " 0 "	1 " 1 "	76 " 1 "	1597
7 " 0 "	1 " 1 "	85 " 6 "	1795

Color: Fill a clean long bottle of colorless glass with the water; look through it at some black object. It should look colorless and free from suspended matter. A muddy or turbid appearance indicates soluble organic matter or solid matter in suspension. Odor: Fill the bottle half full, cork it, and leave it in a warm place for a few hours. If when uncorked it has a smell the least repulsive, it should be rejected for domestic use. Taste: If water at any time, even after heating, has a disagreeable taste, it should be rejected.

A simple semi-chemical test is known as the "Heisch test." Fill a clean pint bottle three-fourths full of the water; add a half-teaspoonful of clean granulated or crushed loaf sugar; stop the bottle with glass or a clean cork and let it stand in a light and moderately warm room for forty-eight hours. If the water becomes cloudy, or milky, it is unfit for domestic use.

Grade Per Mile.

The following table will show the grade per mile:

An inclination of

1 foot in 15 is 352 feet per mile.	1 foot in 40 is 132 feet per mile.
1 foot in 20 is 264 feet per mile.	1 foot in 50 is 106 feet per mile.
1 foot in 25 is 211 feet per mile.	1 foot in 100 is 53 feet per mile.
1 foot in 30 is 176 feet per mile.	1 foot in 125 is 42 feet per mile.
1 foot in 35 is 151 feet per mile.	

To find quantity of water elevated in one minute running at 100 feet of piston speed per minute: Square the diameter of the water cylinder in inches and multiply by 4. Example: Capacity of a 5-inch cylinder is desired. The square of the diameter (5 inches) in 25, which, multiplied by 4, gives 100, the number of gallons per minute (approximately).

To find the depth of a joist, the length of bearing and the thickness being given:

Rule.—Divide the square of the length in feet by the thickness in inches, and the cube root of the quotient, multiplied by 2.2 for pine, or 2.3 for oak, will be the depth in inches.

Capacity of Drain Pipe.

SIZE OF PIPE.	GALLONS PER MINUTE.							
	½-in. Fall per 100 ft.	3-in. Fall per 100 ft.	6-in. Fall per 100 ft.	9-in. Fall per 100 ft.	12-in. Fall per 100 ft.	18-in. Fall per 100 ft.	24-in. Fall per 100 ft.	36-in. Fall per 100 ft.
3-inch	21	30	42	52	60	74	85	104
4 "	36	52	76	92	108	132	148	184
6 "	84	120	169	206	240	294	338	414
9 "	232	330	470	570	660	810	930	1140
12 "	470	680	960	1160	1360	1670	1920	2350
15 "	830	1180	1680	2040	2370	2920	3340	4100
18 "	1300	1850	2630	3200	3740	4600	5270	6470
20 "	1760	2450	3450	4180	4860	5980	6850	8410

Table showing the velocity of discharge of different sized sewers.

Diam. of pipe.	180 feet per minute, 3 feet per second.		270 feet per minute, 4½ feet per second.		360 feet per minute, 6 feet per second.		540 feet per minute, 9 feet per second.	
	Fall.	Gallons per minute.	Fall.	Gallons per minute.	Fall.	Gallons per minute.	Fall.	Gallons per minute.
3.....	1 in 69	54	1 in 30.4	81	1 in 17.2	108	1 in 7.6	162
4.....	1 in 92	96	1 in 40.8	144	1 in 23.	192	1 in 10.2	288
6.....	1 in 138	216	1 in 61.2	324	1 in 34.5	432	1 in 15.3	648
9.....	1 in 207	495	1 in 92.	742.5	1 in 51.7	990	1 in 23	1,485

Some of the Physical Properties of Metals—Compiled from the Best Authorities.

Common Name.	Chemical Name.	Initial.	Atomic Weight.	Specific Gravity.	Weight Cubic Inch.	Weight Cubic Foot.	Melting Point F.	Specific Heat.	Conductivity of Heat.	Conductivity of Electricity.	Expansion 32 to 212° F.	Hardness, the Diamond.—3010.	Density.	Ductility, Gold Being 1.	Malleability, Gold Being 1.	Approximate price per lb. avoirdupois.
Hydrogen	Same.	H.	1.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	\$ 16.30
Aluminum	Same.	Al.	27.3	2.55	.0924	159.005	1160	.214	31.33	.....	.....	821	.....	.....	.....	0.36
Antimony	Same.	Sb.	122.0	6.74	.242	418.402	812	.0508	4.03	1.6	.....	.....	.....	.....	.....	1.95
Bismuth	Same.	Bi.	207.5	9.823	.354	612.513	510	.0308	1.8	1.1	.004	.....	10.025	.....	.....	3.26
Cadmium	Same.	Cd.	111.6	8.60	.31	536.253	500	.0567	20.06	.....	.0094	760	8.217	.....	.....	0.22
Copper	Cuprum	Cu.	63.3	8.82	.318	549.971	1930	.093	74.8	91.1	.0051	1360	.....	6	3	299.72
Gold	Aurum	Au.	196.2	19.32	.697	1224.699	1915	.0324	51.8	73.0	.....	979	.....	1	1	466.59
Indium	Same.	Ir.	196.7	22.42	.809	1392.999	4500	.0326	.....	.....	.....	981	.....	.....	.....	0.015
Iron	Ferrum	Fe.	55.9	7.8	.281	486.369	3000	.1138	10.1	15.5	.0035	1375	.....	4	8	0.06
Lead	Plumbum	Pb.	206.4	11.37	.110	708.976	625	.0344	7.9	7.6	.0084	570	10.370	9	6	45.30
Magnesium	Same.	Mg.	23.91	1.74	.628	89.791	1200	.25	31.3	.....	.0083	726	.....	.....	.....	108.72
Manganese	Same.	Mn.	58.8	8.0	.289	498.84	3120	.122	.....	.....	.....	1456	.....	.....	.....	1.00
Mercury	Hydargyrum	Hg.	199.8	13.58	.190	816.781	39	.0217	1.3	.....	.0182	0	.....	.....	.....	5.80
Nickel	Same.	Ni.	58.6	8.80	.318	551.842	3000	.109	.....	13.1	.0038	1410	.....	5	9	122.31
Platinum	Same.	Pt.	196.7	21.50	.777	155.887	3200	.0324	9.4	16.6	.0027	1107	.....	3	5	22.65
Potassium	Kalium	K.	39.04	.875	.0316	54.561	110	.165	.....	.....	.....	230	.....	.....	.....	18.60
Silver	Argentum	Ag.	107.66	10.53	.38	656.598	1750	.056	100.00	100.0	.0056	990	.....	2	2	3.26
Sodium	Natrium	Na.	23.0	.9735	.035	60.503	170	.293	36.5	.....	.....	400	.....	.....	.....	0.025
Steel	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.25
Tin	Stannum	Sn.	117.8	7.293	.263	489.736	2550	.1465	11.6	12.0	.....	.....	.....	8	4	6.180
Zinc	Same.	Zn.	61.9	7.14	.258	151.751	440	.055	15.4	11.4	.0069	651	7.025	7	7	0.10

LAW OF SPECIFIC HEAT—In order to raise the temperature of different bodies the same number of thermometric degrees very different amounts of heat are required. The atoms of the solid element possess sensibly the same specific heat.

DUCTILITY—The property of being drawn into wire or threads.

MALLEABILITY—The capacity of being extended in all directions by beating with the hammer.

Limes and Cements.—Natural limes and cements are produced by calcining limestones and other calcareous materials, in which process the carbonic acid and moisture they contain are driven off.

Hydraulic Limes are calcined from stone containing 73 to 92 per cent. of carbonate of lime, and a portion of clay, also soluble silica, carbonate of magnesia, alkalies, metallic oxides, and sulphates.

Cements.—There is no precise line between hydraulic limes and cements, the latter containing a larger proportion of clay than limes.

Natural Cements are calcined from stones containing carbonate of lime, a mixture of carbonate of lime and magnesia, together with a proportion of from 30 to 50 per cent. of clay. More than 40 per cent. of clay is injurious to the cements.

Hydraulic Cements are artificial cements made in a similar manner to hydraulic lime, but with a larger proportion of clay, silica, alumina, magnesia, etc. They do not slack after calcination, and some set under water at a temperature of 65 degrees in from 3 to 5 minutes and others in as many hours.

Portland Cement is an artificial cement. Good cement should be ground very fine, and should weigh from 95 to 130 pounds to the striked bushel. Slow setting cement is strongest. It is very important that sand used with cement be perfectly clean and sharp.

Mortar is lime and sand mixed with water. The setting process is a chemical change, the lime and the carbonic acid in the air combining to form a carbonate of lime, which as a cementing element encloses and binds together the particles of sand. The sand should be perfectly free from clay, loam or other impurities, or substitutes for sand may be used in the shape of well burnt clay, coriae from iron-works, slag from furnaces and cinders from coals.

Gypsum, or hydrated sulphate of lime is the basis of most plasters. It is a soft stone, which is either simply calcined, or calcined and combined with salts and alkalies.

Plaster of Paris is gypsum gently calcined till nearly the whole of the moisture is driven off. It can be cast in almost any form in wax or guttapercha moulds. It is also used with other plasters to quicken the setting.

Keene's Cement is plaster of paris soaked in a solution of alum and recalcined.

Parian Cement is gypsum calcined and powdered and mixed with a solution of borax, recalcined, ground, and mixed with a solution of alum.

Coarse Stuff is lime water mixed with hair or fiber.

Fine Stuff is lime slaked to a paste run to the consistency of cream, and allowed to harden to the required consistency for working by evaporation.

Gauged Stuff is plaster of paris added in the proportion of about 1 to 4 for its more rapid setting.

Rough Cast is washed gravels mixed with hot hydraulic lime; it is thrown with large trowels in a semi-fluid state upon an even surface of coarse stuff, and colored with lime wash and ochre.

Depeter is a "pricked up" coat of coarse stuff, into which small stone are pressed while in a wet state.

Depretor is plaster finished with a surface similar to cooled stone.

Pugging is coarse stuff put between floors for the purpose of deafening.

Papier Mache is paper reduced to a pulp or sheets of paper glued together and pressed in a metal mould to a required form.

Carton Pierre is similar to papier mache, but made with paper pulp, whiting and size, pressed into plaster moulds.

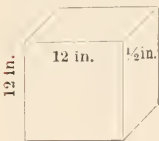
Fibrous Plaster is plaster of Paris in a thin coat laid on canvas strained on framework.

Corrosion of Steel and Iron

C=Coefficient of Corrosion during 1 year's exposure in pounds avoirdupois per square foot.
 (For value of C see table.)
W=Weight in pounds of 1 foot in length of section exposed.
L=Length in feet of the perimeter exposed. If both the inside and outside perimeter are exposed to the Corrosive influence both must be included.
Y||† The number of years of life of the metal.
 Formula $Y = \frac{W}{C L}$

Table of Value of C.

	Corroding Agents.					
	Foul Sea Water.	Clear Sea Water.	Foul River Water.	Pure Air or Clear River Water.	Air of City Manufacturing District or Sea Water.	Sea Water of Average Foulness.
Cast Iron.....	.0656	.0635	.0381	.0113	.0476	.....
Wrought Iron.....	.1956	.1285	.1440	.0123	.1254	.....
Steel.....	.1914	.0970	.1133	.0125	.1252	.....
Cast Iron, planed.....	.2301	.0888	.0728	.0109	.0884	.....
“ “ galvanized.....	.0895	.0359	.0371	.0371	.0199	.....
“ “ in contact with brass.....	.....	.....	.....	.....	.....	.1908
“ “ “ “ copper.....	.....	.....	.....	.....	.....	.2003
“ “ “ “ gun metal.....	.....	.....	.....	.....	.....	.3493
Best Wrought Iron in contact with brass.....	.....	.....	.....	.....	.....	.2779
“ “ “ “ “ copper.....	.....	.....	.....	.....	.....	.4012
“ “ “ “ “ gun metal.....	.....	.....	.....	.....	.....	.4537



Example=Steel.

W=12-in. x 12-in. x 1/2-in. x .283=20.376 pounds.
L=1 ft. 0-in.
C=.1252 from table.

$$Y = \frac{W}{C L} = \frac{20.376}{.1252 \times 1} = \frac{20.376}{.1252} = 62.667 \text{ years.}$$

The corrosion of steel unprotected in manufacturing districts of cities would therefore amount to 20.38 pounds in 162.67 years of the above dimensions of block of steel, or in that time it would be entirely consumed by oxidization.

NEW VIEW OF THE CAUSE OF THE CORROSION OF IRON.

By Dr. Allerton S. Cushman of the U. S. Dept. of Agr.

A number of new points are advanced, "among which the most startling are that oxygen plays only a secondary role in the rusting of iron, and that the best preventatives of rust are to be found among the most effective oxidizing agents known, such as chromic acid and its salts. This view is so contrary to all previous conceptions that it is naturally received with some incredulity when first heard, yet those who are familiar with the investigations and conceptions upon which the new theory of corrosion is based are of the opinion that the evidence which has been brought forward is not only convincing but conclusive."

"The fact that chromic acid and its salts act as inhibitors of rusting has been known for some time, but no explanation of the curious phenomenon has ever been offered heretofore nor has its application to practice ever been suggested."—(Eng. Rec. Vol. 56, p. 1.)

General William Sooy Smith says iron exposed to steam and sulphur fumes is eaten away by corrosion at the rate of 1/18 of an inch per annum, as was the case in the floor system of the Milwaukee Avenue viaduct, Chicago, Ill., under which locomotives were passing frequently; also Western approach Eads Bridge, St. Louis, Mo.

	Copper.	Tin.	Lead.	Zinc.	Silver.	Bismuth	Gold.	Cadmium.	Antimony
Tin		25	75						
Tin		58	16			16			10
Tin, coarse, melts at 500° ..		33	67						
Tin, ordinary, melts at 360° ..		67	33						
Spelter, soft	50			50					
Spelter, hard	65			35					
Lead		33	67						
Steel	13			5	82				
Brass or Copper	50			50					
Fine Brass	47			47	6				
Pewterer's, or soft		33	45			22			
Pewterer's, or soft		50	25			25			
Plumber's pot metal		33	67						
“ “ coarse		25	75						
“ “ fine		67	33						
“ “ fusible		50	50						
“ “ very fusible		25	25			50			
Gold	4				7		89		
Gold, hard	66			34					
Gold, soft		66	34						
Silver, hard	20				80				
Silver, soft	12				67			21	
Pewter		40	20			40			
Iron	66			33					1
Copper	53	47							

Weight per Square Foot of Sheet Lead.

[illegible]

Weights of Materials.

Dry Woods.

	Lbs. Board ft.	Lbs. Cubic ft.		Lbs. Board ft.	Lbs. Cubic ft.
Apple	4.1	49.	Iron Wood	6.	71.
Ash, American white.....	3.9	47.	Larch	3.	35.
Birch	3.9	45.	Lignum vitæ	6.9	83.
Beech	3.7	43.	Mahogany, Honduras	2.9	35.
Boxwood	5.	60.	Mahogany, Spanish	4.4	53.
Cedar, American	2.9	35.	Maple	4.1	49.
Cedar, W. Indian	3.9	47.	Maple, soft	3.5	42.
Cedar, Lebanon	2.5	30.	Oak, live	4.9	59.3
Cherry	3.5	42.	Oak, red	3.9	45.
Chestnut	3.4	41.	Oak, white	4.3	52.
Cork	1.3	15.	Pine, Southern	3.7	45.
Elm	2.9	35.	Pine, white	2.1	25.
Ebony	6.3	76.1	Pine, yellow	2.8	34.3
Hemlock	2.1	25.	Spruce	2.1	25.
Hickory	4.4	53.	Sycamore	3.1	37.
Hornbeam	2.9	47.	Walnut	3.2	38.

Building Materials.

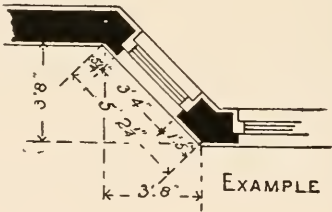
	Lbs. Cubic ft.		Lbs. Cubic ft.
Brick, pressed	150	Common brickwork, cement mortar.	130
Brick, common	125	Common brickwork, lime mortar...	120
Cement, Portland	80 to 100	Concrete cement	140
Cement, Rosedale	56	Earth dry, shaken	82 to 92

	Lbs. Cubic ft.		Lbs. Cubic ft.
Earth, rammed	92 to 100	Mortar, hardened	103
Glass, window	157	Plaster of paris	141.6
Granite	170	Sand	90-106
Granite or limestone, rubble work...	138	Sandstone	151
Granite or limestone, well dressed..	165	Shales	162
Limestones and marbles	168	Slate	175
Lime, quick	53	Trap rock	187

Results of tests by Prof. Thomas Wilson to ascertain the amount of light passing through or obstructed by glass.

	Percentage of Light.	
	Admitted.	Obstructed.
American Crystal, ground one side	50.00	50.00
Clear Plate.....	87.50	12.50
American Crystal, clear, double thick.....	87.50	12.50
American Crystal, clear, single thick.....	87.50	12.50
Plate, ground one side.....	50.00	50.00
Plate, ground two sides.....	37.50	62.50
American Crystal, ground two sides.	37.50	62.50
Hammered 1/4 inch thick	87.50	12.50
Ribbed 1/4 inch thick.....	75.00	25.00

Table Showing the Length of Sides of Bays, Angle being 45 Degrees.



1 ft. 6 in. by 1 ft. 6 in.....	2 ft. 1 1/8 in.	2 ft. 10 in. by 2 ft. 10 in.....	4 ft. 0 1/8 in.
1 " 7 " " 1 " 7 ".....	2 7/8 "	2 " 11 " " 2 " 11 ".....	4 " 1 1/2 "
1 " 8 " " 1 " 8 ".....	4 1/4 "	3 " 0 " " 3 " 0 ".....	4 " 2 1/8 "
1 " 9 " " 1 " 9 ".....	5 1/8 "	3 " 1 " " 3 " 1 ".....	4 " 4 1/8 "
1 " 10 " " 1 " 10 ".....	7 1/8 "	3 " 2 " " 3 " 2 ".....	4 " 5 3/4 "
1 " 11 " " 1 " 11 ".....	8 1/2 "	3 " 3 " " 3 " 3 ".....	4 " 7 1/8 "
2 " 0 " " 2 " 0 ".....	9 1/8 "	3 " 4 " " 3 " 4 ".....	4 " 8 3/8 "
2 " 1 " " 2 " 1 ".....	11 3/8 "	3 " 5 " " 3 " 5 ".....	4 " 10 "
2 " 2 " " 2 " 2 ".....	13 1/4 "	3 " 6 " " 3 " 6 ".....	4 " 11 3/8 "
2 " 3 " " 2 " 3 ".....	15 1/4 "	3 " 7 " " 3 " 7 ".....	4 " 13 1/8 "
2 " 4 " " 2 " 4 ".....	17 1/2 "	3 " 8 " " 3 " 8 ".....	4 " 15 1/8 "
2 " 5 " " 2 " 5 ".....	19 1/2 "	3 " 9 " " 3 " 9 ".....	4 " 17 1/8 "
2 " 6 " " 2 " 6 ".....	21 1/2 "	3 " 10 " " 3 " 10 ".....	4 " 19 1/8 "
2 " 7 " " 2 " 7 ".....	23 1/2 "	3 " 11 " " 3 " 11 ".....	4 " 21 1/8 "
2 " 8 " " 2 " 8 ".....	25 1/2 "	4 " 0 " " 4 " 0 ".....	4 " 23 1/8 "
2 " 9 " " 2 " 9 ".....	27 1/2 "		

RULE FOR CALCULATING PROPORTIONED WIDTH AND HEIGHT OF TREADS AND RISES OF STAIRS

Subtract the width of tread from 25 in. and the result will be twice the height of the riser. Thus: if the tread is 10 in. wide, then 25 — 10 = 15 ÷ 2 = 7½ in., the height or riser proportionate to a 10-inch tread. This is exclusive of nosings.

TABLE OF TREADS AND RISES.

No. of Treads,	6	6 $\frac{1}{4}$	6 $\frac{1}{2}$	6 $\frac{3}{4}$	7	7 $\frac{1}{4}$	7 $\frac{1}{2}$	7 $\frac{3}{4}$	8	8 $\frac{1}{4}$	8 $\frac{1}{2}$	9	9 $\frac{1}{4}$	10	10 $\frac{1}{2}$	11	13	14
Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.	Inch Rise, ft., in.
1	6	6 $\frac{1}{4}$	6 $\frac{1}{2}$	6 $\frac{3}{4}$	7	7 $\frac{1}{4}$	7 $\frac{1}{2}$	7 $\frac{3}{4}$	8	8 $\frac{1}{4}$	8 $\frac{1}{2}$	9	9 $\frac{1}{4}$	10	10 $\frac{1}{2}$	11	13	14
2	1 0	1 0 $\frac{1}{4}$	1 1	1 1 $\frac{1}{4}$	1 2	1 2 $\frac{1}{4}$	1 2 $\frac{1}{2}$	1 3 $\frac{1}{4}$	1 4	1 4 $\frac{1}{4}$	1 5	1 6	1 7	1 8	1 9	1 10	2 2	2 4
3	1 6	1 6 $\frac{1}{4}$	1 7 $\frac{1}{2}$	1 8 $\frac{1}{4}$	1 9	1 9 $\frac{1}{4}$	1 10 $\frac{1}{2}$	1 11 $\frac{1}{4}$	2 0	2 0 $\frac{1}{4}$	2 1 $\frac{1}{2}$	2 3	2 4 $\frac{1}{2}$	2 6	2 7 $\frac{1}{2}$	2 9	3 3	3 6
4	2 0	2 1	2 2	2 3	2 4	2 4 $\frac{1}{2}$	2 5	2 5 $\frac{1}{2}$	2 6	2 6 $\frac{1}{4}$	2 7	2 7 $\frac{1}{2}$	3 0	3 4	3 6	4 4	4 4	4 8
5	2 6	2 7 $\frac{1}{4}$	2 8 $\frac{1}{2}$	2 9 $\frac{1}{4}$	2 11	2 11 $\frac{1}{4}$	3 0 $\frac{1}{2}$	3 0 $\frac{3}{4}$	3 1 $\frac{1}{2}$	3 2 $\frac{1}{4}$	3 3	3 3 $\frac{1}{2}$	4 2	4 2	4 4 $\frac{1}{2}$	5 5	5 5	5 10
6	3 0	3 1 $\frac{1}{4}$	3 3	3 4 $\frac{1}{2}$	3 6	3 6 $\frac{1}{4}$	3 7 $\frac{1}{2}$	3 8 $\frac{1}{4}$	4 0	4 1 $\frac{1}{4}$	4 3	4 6	5 0	5 0	5 3	5 6	6 6	7 0
7	3 6	3 7 $\frac{3}{4}$	3 9 $\frac{1}{2}$	4 1	4 1 $\frac{1}{2}$	4 1 $\frac{3}{4}$	4 3 $\frac{1}{2}$	4 5 $\frac{1}{4}$	4 8	4 9 $\frac{1}{4}$	4 11 $\frac{1}{2}$	5 3	5 6 $\frac{1}{2}$	5 10	6 1 $\frac{1}{2}$	6 5	7 7	8 2
8	4 2	4 4	4 6	4 8	4 9	4 10	4 11	5 0	5 4	5 6	5 8	6 0	6 4	6 8	7 4	7 4	8 8	9 4
9	4 6	4 8 $\frac{1}{4}$	4 10 $\frac{1}{2}$	5 0 $\frac{1}{4}$	5 3	5 4 $\frac{1}{2}$	5 5 $\frac{1}{2}$	5 6 $\frac{3}{4}$	6 0	6 2 $\frac{1}{4}$	6 4 $\frac{1}{2}$	6 9	7 1 $\frac{1}{2}$	7 6	7 10 $\frac{1}{2}$	8 3	9 9	10 6
10	5 0	5 2 $\frac{1}{2}$	5 5	5 7 $\frac{1}{2}$	5 10	5 11 $\frac{1}{4}$	6 0 $\frac{1}{2}$	6 1 $\frac{1}{4}$	6 8	6 10 $\frac{1}{4}$	7 1	7 6	7 11	8 4	8 9	9 2	10 10	11 8
11	5 6	5 8 $\frac{3}{4}$	5 11 $\frac{1}{2}$	6 2 $\frac{1}{4}$	6 5	6 6 $\frac{1}{2}$	6 9 $\frac{1}{2}$	7 1 $\frac{1}{4}$	7 4	7 6 $\frac{1}{4}$	7 9 $\frac{1}{2}$	8 3	8 8 $\frac{1}{2}$	9 2	9 7 $\frac{1}{2}$	10 1	11 11	12 10
12	6 0	6 3	6 6	6 9	7 0	7 1 $\frac{1}{2}$	7 4 $\frac{1}{2}$	7 7 $\frac{1}{2}$	8 0	8 3	8 6	9 0	9 6	10 0	10 6	11 0	13 0	14 0
13	6 6	6 9 $\frac{1}{4}$	7 0 $\frac{1}{2}$	7 3 $\frac{1}{4}$	7 7	7 8 $\frac{1}{2}$	7 11 $\frac{1}{4}$	8 1 $\frac{1}{2}$	8 8	8 11 $\frac{1}{4}$	9 2 $\frac{1}{2}$	9 9	10 3 $\frac{1}{2}$	10 10	11 4 $\frac{1}{2}$	11 11	14 1	15 2
14	7 0	7 3 $\frac{1}{2}$	7 7	7 10 $\frac{1}{2}$	8 2	8 3 $\frac{1}{2}$	8 7 $\frac{1}{4}$	9 0 $\frac{1}{2}$	9 4	9 7 $\frac{1}{2}$	9 11	10 6	11 1	11 8	12 3	12 10	15 2	16 4
15	7 6	7 9 $\frac{3}{4}$	8 1 $\frac{1}{2}$	8 5 $\frac{1}{4}$	8 9	8 10 $\frac{1}{2}$	9 0 $\frac{3}{4}$	9 4 $\frac{1}{4}$	10 0	10 3 $\frac{1}{4}$	10 7 $\frac{1}{2}$	11 3	11 10 $\frac{1}{2}$	12 6	13 1 $\frac{1}{2}$	13 9	16 3	17 6
16	8 0	8 4	8 8	9 0	9 4	9 6	9 8	10 2	10 8	11 0	11 4	12 0	12 8	13 4	14 0	14 8	17 4	18 8
17	8 6	8 10 $\frac{1}{4}$	9 2 $\frac{1}{2}$	9 6 $\frac{1}{4}$	9 11	10 1 $\frac{1}{2}$	10 3 $\frac{1}{4}$	10 9 $\frac{1}{2}$	11 1 $\frac{1}{4}$	11 8 $\frac{1}{4}$	12 0 $\frac{1}{2}$	12 9	13 5 $\frac{1}{2}$	14 2	14 10 $\frac{1}{2}$	15 7	18 5	19 10
18	9 0	9 4 $\frac{1}{2}$	9 9	10 1 $\frac{1}{2}$	10 6	10 8 $\frac{1}{4}$	11 0 $\frac{1}{4}$	11 5 $\frac{1}{4}$	12 0	12 4 $\frac{1}{2}$	12 9	13 6	14 3	15 0	15 9	16 6	21 0	21 0
19	9 6	9 10 $\frac{3}{4}$	10 3 $\frac{1}{2}$	10 8 $\frac{1}{4}$	11 1	11 3 $\frac{1}{2}$	11 5 $\frac{1}{4}$	12 0 $\frac{1}{2}$	12 8	13 0 $\frac{1}{2}$	13 5 $\frac{1}{2}$	14 3	15 0 $\frac{1}{2}$	15 10	16 7 $\frac{1}{2}$	17 5	20 7	22 2
20	10 0	10 5	10 10	11 3	11 8	11 10 $\frac{1}{2}$	12 1	12 8 $\frac{1}{2}$	13 4	13 9	14 2	15 0	15 10	16 8	17 6	18 4	21 8	23 4
21	10 6	10 11 $\frac{1}{4}$	11 4 $\frac{1}{2}$	11 9 $\frac{1}{4}$	12 3	12 5 $\frac{1}{2}$	12 8 $\frac{1}{4}$	13 4 $\frac{1}{4}$	14 0	14 5 $\frac{1}{4}$	14 10 $\frac{1}{2}$	15 9	16 7 $\frac{1}{2}$	17 6	18 4 $\frac{1}{2}$	19 3	22 9	24 6
22	11 0	11 5 $\frac{1}{2}$	11 11	12 4 $\frac{1}{2}$	12 10	13 0 $\frac{1}{2}$	13 3 $\frac{1}{2}$	13 11 $\frac{1}{4}$	14 8	15 1 $\frac{1}{2}$	15 7	16 6	17 5	18 4	19 3	20 2	23 10	25 8
23	11 6	11 11 $\frac{3}{4}$	12 5 $\frac{1}{2}$	12 11 $\frac{1}{4}$	13 5	13 7 $\frac{1}{4}$	13 10 $\frac{1}{4}$	14 1 $\frac{1}{2}$	15 4	15 9 $\frac{1}{4}$	16 3 $\frac{1}{2}$	17 3	18 2 $\frac{1}{2}$	19 2	20 1 $\frac{1}{2}$	21 1	24 11	26 10
24	12 0	12 6	13 0	13 6	14 0	14 3	14 6	15 0	15 3	16 0	16 6	17 0	18 0	19 0	20 0	21 0	26 0	28 0
25	12 6	13 0 $\frac{3}{4}$	13 6 $\frac{1}{2}$	14 0 $\frac{1}{4}$	14 7	14 10 $\frac{1}{8}$	15 1 $\frac{1}{4}$	15 10 $\frac{1}{8}$	16 8	17 2 $\frac{1}{4}$	17 8 $\frac{1}{2}$	18 9	19 9 $\frac{1}{2}$	20 10	21 10 $\frac{1}{2}$	22 11	27 1	29 2
26	13 0	13 6 $\frac{1}{2}$	14 1	14 7 $\frac{1}{2}$	15 2	15 5 $\frac{1}{4}$	15 11 $\frac{1}{4}$	16 3	17 4	17 10 $\frac{1}{2}$	18 5	19 6	20 7	21 8	22 9	23 10	28 2	30 4
27	13 6	14 0 $\frac{1}{4}$	14 7 $\frac{1}{2}$	15 2 $\frac{1}{4}$	15 9	16 0 $\frac{1}{4}$	16 7 $\frac{1}{4}$	17 1 $\frac{1}{4}$	18 0	18 6 $\frac{1}{4}$	19 1 $\frac{1}{2}$	20 3	21 4 $\frac{1}{2}$	22 6	23 6	24 9	29 3	31 6
28	14 0	14 7	15 2	15 9	16 4	16 7 $\frac{1}{2}$	17 2 $\frac{1}{2}$	18 1	18 8	19 3	19 10	21 0	22 2	23 4	24 6	25 8	30 4	32 8
29	14 6	15 1 $\frac{1}{4}$	15 8 $\frac{1}{2}$	16 3 $\frac{1}{4}$	16 11	17 6 $\frac{1}{4}$	17 9 $\frac{1}{4}$	18 2 $\frac{1}{4}$	19 4	19 11 $\frac{1}{4}$	20 6 $\frac{1}{2}$	21 9	22 11 $\frac{1}{2}$	24 2	25 4 $\frac{1}{2}$	26 7	31 5	33 10
30	15 0	15 7 $\frac{1}{2}$	15 15 3	16 10 $\frac{1}{2}$	17 6	17 9 $\frac{3}{4}$	18 1 $\frac{1}{2}$	19 4 $\frac{1}{2}$	20 0	20 7 $\frac{1}{2}$	21 3	22 6	23 9	25 0	26 3	27 6	32 6	35 0

NOMENCLATURE OF DRAWINGS.

FILE 692.1

In response to a request sent out to a large number of prominent architects to send in copies of nomenclature used on their drawings, it was found that this varied with practically every architect, the result being that contractors estimating in different offices are compelled to memorize a large number of different systems of notation before being able to read plans intelligently; same rule applies to draughtsmen going from one office to another, all of which causes much waste of time and greatly increases the possibility of error. With this as an excuse we offer the following series of symbols, selected from the various systems with the hope that it will be generally adopted and thus bring about a greater uniformity of drawing nomenclature. The lighting symbols are taken from the standard symbols for wiring plans, prepared by the National Electrical Contractors Association of the United States. The structural iron symbols are taken from the Osborne system of nomenclature most generally used by structural iron contractors. General symbols are collated from various sources.

Erratum—In the symbol of riser under heating plan symbols, draughtsman has made an error by inserting a small capital "R" instead of a numeral in the riser character.

·LIGHTING SYMBOLS·

- (4) CEILING OUTLET ELECTRIC ONLY NUMERAL IN CENTER INDICATES NO OF STANDARD 16 CP INCAND LAMPS
- (4) 2 CEILING OUTLET COMBINATION 4-16 CP INCANDESCENT LAMPS & 2 GAS BURNERS
- (1) 2 BRACKET OUTLET ELECTRIC ONLY NUMERAL IN C INDICATES NO OF STANDARD 16 CP INCAND LAMPS
- (1) 2 BRACKET OUTLET COMBINATION 4-16 CP INCANDESCENT LAMPS & 2 GAS BURNERS
- (1) 2 WALL OR BASEBOARD RECEPTACLE OUTLET NUMERAL IN C INDICATES NO OF STANDARD 16 CP INCAND LAMPS
- (1) FLOOR OUTLET NUMERAL IN C INDICATES NO OF STANDARD 16 CP INCAND LAMPS
- BELL OUTLET
- BUZZER OUTLET
- (5) CEILING OUTLET, GAS ONLY NUMERAL IN C INDICATES NO OF GAS BURNERS.
- (3) BRACKET OUTLET, " " " " "
- (F) GAS OUTLET FOR FUEL GAS

STRUCTURAL IRON SYMBOLS.

- TWO FULL HEADS
- COUNTERSUNK INSIDE (FARSIDE) & CHIPPED
- " OUTSIDE (NEARSIDE) " "
- " BOTH SIDES " "
- INSIDE (FARSIDE) OUTSIDE (NEARSIDE) BOTH SIDES
- " FLATTENED TO $\frac{1}{8}$ " HIGH OR COUNTERSUNK AND NOT CHIPPED
- " FLATTENED TO $\frac{1}{4}$ " HIGH
- " " $\frac{3}{8}$ "

·GENERAL SYMBOLS·

- (5) 8'x10' GIDER, NUMERAL INDICATES SIZE, ENCLOSED NUMERAL IND. PARTICULAR GIRDER.
- (7) SIZE HERE COLUMN, SMALL NUMERAL INDICATES NUMBER OF PARTICULAR COLUMN
- (25) DOOR, SMALL NUMERAL INDICATES NUMBER OF PARTICULAR DOOR
- (50) WINDOW, SMALL NUMERAL INDICATES NUMBER OF PARTICULAR WINDOW
- (5) 3 INDICATES DESIGNATING NUMBER OF ROOM
- (+7'-6) ELEVATION OF POINT SMALL NUMERALS INDICATE DISTANCE ABOVE ZERO POINT IF PRECEDED BY - REFER TO POINT BELOW ZERO
- BRICK
- CONCRETE
- WALLS WITH WOOD FURRING & LATH & PLASTER
- " " METAL " " " "
- " " TILE " & PLASTER
- HOLLOW TILE CONSTRUCTION
- WALL OF WOOD STUDS & LATH & PLASTER
- STONE
- RUBBLE
- RUBBLE STONE
- DIMENSION STONE
- ASHLAR STONE
- DRESSED ASHLAR
- ROCK FACED ASHLAR
- ANY STONE DRESSED
- NOT DESCRIBED SMALL NUMERALS REFER TO DETAILS & SPECIFICATIONS
- STORM SEWER
- DRAINAGE SYSTEM
- SANITARY SEWER

·SYMBOLS FOR HEATING PLANS·

- SMALL NUMERAL DESIGNATES PARTICULAR RISER, ARROW LOCATES SAME & INCH FIGURE GIVES SIZE.
- SMALL NUMERAL DESIGNATES PARTICULAR RADIATOR
- SMALL NUMERAL IN INCHES GIVES SIZE AND ARROW LOCATES FEED
- " " " " " " RETURN
- INDICATES DIRECTION OF FLOW
- " " " " " " POUL AIR
- HOT AIR
- 14 12x14" ENCLOSED NUMERAL INDICATES PARTICULAR REGISTER, INCHES INDICATE SIZE
- 15 12" SMALL NUMERAL INDICATES NO OF LEADER INCHES INDICATE INTERIOR DIAMETER, ARROW INDICATES DIRECTION OF FLOW
- 3 1/2 x 18 1/2 7 SMALL NUMERAL INDICATES NO OF PARTICULAR STACK, INCHES INDICATE SIZE

TO FIND AREA OF CIRCLE.

FILE 692.1

When finding the area of a circle in the usual way by squaring the diameter and multiplying by .7854, four multiplications are required, one for each digit. The following method requires only one. Example: To find the area of a circle of 3.7 inches diameter, $3.7 \times 3.7 = 13.69$. Then

13.69 As will be readily seen, this sum consists in multiplying the top line by
 .7854 seven, repeating one place to the right, doubling the above, and repeating
 as before. It may be proved thus:

9583	7
9583	7
19166	14
19166	14
16.752126	7854

If the proof only is memorized the method is fixed in the brain forever.

TO FIND THE RADIUS OF AN ARCH.

Centers—The following is the method to find the radius for arch centers $S =$ span $R =$ rise
 Then $\left\{ \frac{\left(\frac{S}{2} \right)^2}{R} + R \right\} \div 2$ or: To the square of half the span divided by the rise, add the rise and divide this sum by 2, and the result will be the radius required.

Example:—Suppose an arch 20 feet span and 5 feet rise then:

$$\left\{ \frac{10^2}{5} + 5 \right\} \div 2 = \frac{20 + 5}{2} = 12 \text{ ft. 6 in. the radius required.}$$

MEASUREMENT OF OLD BRICKS.

FILE 692.5

Uncleaned rough from building dumped from 8 to 10 bricks per cu. ft.

Uncleaned stacked on outside and interior filled promiscuously, 10-12 per cu. ft.

Cleaned and stacked, 16 to 18 bricks per cu. ft.

Cleaned, stacked on outside and interior filled promiscuously, 12-14 per cu. ft.

MEMORANDA FOR PAINTERS.

Painters' work is generally estimated by the yard, and the cost depends upon the number of coats applied, besides the quality of the work, and the material to be painted.

One coat or priming, will take, for 100 yards of painting, twenty pounds of lead and four gallons of oil. Two-coat work, forty pounds of lead and four gallons of oil. Three-coat work, the same proportionate quantity as two coats; so that a fair estimate for 100 yards of three-coat would be 100 pounds of lead and sixteen gallons of oil.

One gallon priming oil color will cover 50 superficial yards.

One pound of paint covers about four superficial yards the first coat, and about six each additional coat. One pound of putty, for stopping every twenty yards.

One gallon of tar and one pound of pitch will cover twelve yards superficial the first coat, and seventeen yards each additional coat.

A day's work on the outside of a building is 100 yards of first coat, and 80 yards of either second or third coat. An ordinary door, including casings, will, on both sides, make eight to ten yards of painting, or about five yards to a door without casings. An ordinary window makes about two and one-half or three yards.

WEIGHT OF BRICKWORK.

FILE 693.2

Placing the weight of brickwork at 112 lb. per cubic foot, the weights per superficial foot for different walls are:

9 inch wall.....	84 lb.
13 inch wall.....	121 lb.
18 inch wall.....	168 lb.
22 inch wall.....	205 lb.
26 inch wall.....	243 lb.

Length in Feet of Joists, Scantling and Timber.

FILE 694.0

Size in Inches	12	14	16	18	20	22	24	26	28	30	42	44	45
2 x 4	8	9	11	12	13	15	16	17	19	20	28	29	30
2 x 6	12	14	16	18	20	22	24	26	28	30	42	44	45
2 x 8	16	19	21	24	27	29	32	35	37	40	56	58	60
2 x 10	20	23	27	30	33	37	40	43	47	50	70	74	75
2 x 12	24	28	32	36	40	44	48	52	56	60	84	88	90
3 x 4	12	14	16	18	20	22	24	26	28	30	42	44	45
3 x 6	18	21	24	27	30	33	36	39	42	45	63	66	68
3 x 8	24	28	32	36	40	44	48	52	56	60	84	88	90
3 x 10	30	35	40	45	50	55	60	65	70	75	105	110	113
3 x 12	36	42	48	54	60	66	72	78	84	90	126	132	135
4 x 4	16	19	21	24	27	29	32	35	37	40	56	58	60
4 x 6	24	28	32	36	40	44	48	52	56	60	84	88	90
4 x 8	32	37	43	48	53	59	64	69	75	80	112	118	120
4 x 10	40	47	53	60	67	73	80	87	93	100	140	146	150
4 x 12	48	56	64	72	80	88	96	104	112	120	168	176	180
6 x 6	36	42	48	54	60	66	72	78	84	90	126	132	135
6 x 8	48	56	64	72	80	88	96	104	112	120	168	176	180
6 x 10	60	70	80	90	100	110	120	130	140	150	210	220	225
6 x 12	72	84	96	108	120	132	144	156	168	180	250	265	270
8 x 8	64	75	85	96	107	117	128	139	149	160	224	234	240
8 x 10	80	93	107	120	133	147	160	173	187	200	280	291	300
8 x 12	96	112	128	144	160	176	192	208	224	240	336	352	360
10 x 10	100	117	133	150	167	183	200	217	233	250	350	366	375
10 x 12	120	140	160	180	200	220	240	260	280	300	420	440	450
12 x 12	144	168	192	216	240	264	288	312	336	360	504	528	540
12 x 14	168	196	224	252	280	308	336	364	392	420	588	616	630
14 x 14	196	220	261	294	327	359	392	425	457	480	686	718	735

NAILS REQUIRED FOR DIFFERENT KINDS OF WORK.

FILE 694.231

For 1,000 shingles, 3½ to 5 lbs. 4d. nails, or 3 to 3½ lbs. 3d.

For 1,000 laths, about 7 lbs. 3d. fine.

For 1,000 feet clapboards, about 18 lbs. 6d. box.

For 1,000 feet covering boards, about 20-lbs. 8d. common. or 25 lbs. 10d.

For 1,000 feet upper floors, square edged, about 38 lbs. 10d. floor, or 41 lbs. 12d. floor.

For 1,000 feet upper floors, matched and blind-nailed, 38 lbs. 10d., or 42 lbs. 12d. common.

For 10 feet partitions, studs or studding, 1 lb. 10d. common.

For 1,000 feet furring, 1x3, about 45 lbs. 10d. common.

For 1,000 feet furring, 1x2, about 65 lbs. 10d. common.

For 1,000 feet pine finish, about 30 lbs. 8d. finish.

GRADING OF PINE OR HEMLOCK JOISTS, SCANTLING AND TIMBER.

1. No. 1 joists and scantling must be of a good, sound character, but will admit of defects that do not impair the strength of the piece.

2. On basis of 2x4, wane on edge is admissible, one-half inch deep, for half the length, or a proportionate amount for a shorter distance or on both edges. In any case, one side and two edges should allow a good nailing surface. It being understood, however, that the wane shall in no case extend over one-half the side of the piece.

3. A few worm holes admissible.

4. Stained sap is not considered a defect.

5. Timbers and 3-inch plank admit proportionately greater defects.

6. 2-inch dimensions of this grade may contain 20 per cent of No. 1 tamarack, and 3-inch and thicker and timbers may contain any amount of No. 1 tamarack.

1. No. 2 will admit of large, coarse knots, not necessarily sound, considerable wane, also shake, worm holes, red, dozy streaks, crooked pieces or other defects which weaken or impair the piece to such an extent as to render it unfit for No. 1 grade.

2. Any amount of No. 2 tamarack is admissible in this grade.

No. 3 will admit a great deal of rot and all the imperfections allowed in No. 1 and No. 2, but in a much more pronounced form, and any amount of No. 3 tamarack.

RULES AND FORMULAS FOR THE DESIGN OF SIMPLE WOOD BEAMS OR JOISTS.

When a beam is to be designed its length and the loads to which it is to be subjected are known, thus the maximum bending moment may be found.

The **allowable-working-strength** is assumed in accordance with engineering practice and must not be more than allowed by building laws, locally applicable. This **allowable-working-strength** is usually stated in municipal codes as a fixed number of pounds per square inch of cross sectional area, for each kind of material. This might just as well be stated in pounds or any other unit of weight per square foot or any other unit of area, it being only important that whatever unit of dimension is used that the same unit shall be used both for areas, lengths and breadths.

Breadth-of-the-beam times **the-square-of-the-depth** divided by six equals **Bending-Moment** divided by **allowable-working-strength** per unit of area corresponding with unit of length used for stating the length and breadth of beam.

Bending-Moment (for beams uniformly loaded) equals **weight-to-be-supported-per-unit-of-length** times **the-square-of-the-total-number-of-units-of-length** divided by eight.

For a simple beam loaded with a single weight, the **maximum-Bending-Moment** (which is to be used in formula) equals **the-entire-load** times [(**the-length-of-the-beam**) minus (**the-distance-of-the-load-from-the-left-hand-end**)] times **the-distance-of-the-load-from-the-left-hand-end-of-the-beam** divided by **the-length-of-the-beam**.

If the load be movable **the-distance-of-load-from-left-hand-end** will be variable and the **maximum-moment** will be developed when the load is at the middle where the **maximum-Bending-Moment** is equal to **one-fourth-the-load** times **the-length-of-the-beam**. Placing the entire load on a beam at its center therefore produces the maximum strain that it is possible to produce on such beam by any position of such load.

APPLICATION OF ABOVE PRINCIPLES.

M=maximum bending moment.

S=the tensile or compressive unit stress per square inch allowable by building code or engineering practice for the material selected (See Section 595, Chicago Municipal Code).

l=length in inches of beam between supports.

b=breadth in inches of the beam.

d=depth in inches of the beam.

w=weight in pounds on beam including the weight of the beam itself per each inch of length.

W=total weight in pounds on beam=l w.

FOR UNIFORM LOADING.

$$b = \frac{3 w l^2}{4 d^2 S} = \frac{3 W l}{4 d^2 S} = \text{breadth of beam.} \quad d = \sqrt{\frac{3 w l^2}{4 b S}} = \sqrt{\frac{3 W l}{4 b S}} = \text{depth of beam.}$$

To find **b** it is necessary to assume a value for **d**. Also to find **d** it is necessary to assume a value for **b**. In case it is found that the value by formula is too large or too small for practical use, then assumed value must be changed so as to bring the computed value to a practical size.

WHITE PINE OR SPRUCE C. M. C. REQ. FOR UNIFORM LOADING.

$$b = \frac{3 w l^2}{4 d^2 750} = \frac{w l^2}{1000 d^2} = \frac{W l}{1000 d^2} = \text{breadth of beam.}$$

$$d = \sqrt{\frac{w l^2}{1000 b}} = \sqrt{\frac{W l}{1000 b}} = \text{depth of beam.}$$

WHITE OAK C. M. C. REQ. FOR UNIFORM LOADING.

$$b = \frac{3 w l^2}{4 d^2 1000} = \frac{3 w l^2}{4000 d^2} = \frac{3 W l}{4000 d^2} = \text{breadth of beam.}$$

$$d = \sqrt{\frac{3 w l^2}{4000 b}} = \sqrt{\frac{3 W l}{4000 b}} = \text{depth of beam.}$$

LONG-LEAVED YELLOW PINE C. M. C. REQ. FOR UNIFORM LOADING.

$$b = \frac{3 w l^2}{4 d^2 1250} = \frac{3 w l^2}{5000 d^2} = \frac{3 W l}{5000 d^2} = \text{breadth of beam.}$$

$$d = \sqrt{\frac{3 w l^2}{5000 b}} = \sqrt{\frac{3 W l}{5000 b}} = \text{depth of beam.}$$

Table of greatest center loads for horizontal rectangular beams of white or yellow pine, or of spruce, 1 inch broad, supported at both ends, and required not to bend more than $\frac{1}{10}$ inch per foot of clear span, or $\frac{1}{480}$ part of the entire clear span. In practice, to allow for knots, &c., take only $\frac{3}{4}$ rds.

This table was calculated with a constant .000325, instead of .00032. The loads in this table include the weight of the clear beam itself: .625 of which (or % of which) must be deducted from the tabular loads to get the neat load, when the beam is loaded at its center. When uniformly loaded, the loads will be 1.6 times as great as those in this table; but in that case the weight of the entire clear beam must be deducted. In practice this deduction need rarely be made.

CLEAR SPANS IN FEET.																			(TRAUTWINE)										Depth in Ins.	Wt. of 10 ft. Beam.
3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	lbs.	lbs.												
1	8.4	4.8	3.0	2.1													1													
2	28.7	16.2	10.4	7.2													2													
3	68.4	38.4	24.4	17.1													3													
4		75	48	33	24	19	14										4													
5		130	83	58	42	32	26	21									5													
6			131	92	67	51	40	33	23								6													
7			196	137	100	77	60	49	34	25							7													
8				144	108	86	70	58	48	37	27						8													
9				196	144	116	96	80	66	55	45	32					9													
10					196	156	128	108	90	75	62	50	32				10													
11						200	166	134	115	96	81	66	52	26			11													
12							204	148	129	109	93	77	63	52	21		12													
13								183	134	102	84	68	56	44			13													
14									166	126	100	82	67	54			14													
15										102	81	65	52	41			15													
16											100	80	66	52	42		16													
17												98	63	51	43		17													
18													74	52	40	24	18													
19														90	62	48	29	19												
20															104	72	52	40												
21																85	63	49												
22																	98	71												
23																		114												
24																		129												
25																		185												
26																		231												
27																		283												
28																		337												
29																		391												
30																		445												
31																		499												
32																		553												
33																		607												
34																		661												
35																		715												
36																		769												
37																		823												
38																		877												
39																		931												
40																		985												
41																		1039												
42																		1093												
43																		1147												
44																		1201												
45																		1255												
46																		1309												
47																		1363												
48																		1417												
49																		1471												
50																		1525												
51																		1579												
52																		1633												
53																		1687												
54																		1741												
55																		1795												
56																		1849												
57																		1903												
58																		1957												
59																		2011												
60																		2065												

On this side of the dark lines, the safe loads of table.

Iron and Steel.

such as $\frac{1}{4}$ of their clear span.

Average cast iron, with the same safe def will bear about 11% as much as common yellow or white pine, or spruce; and wrought iron 19 times as much. The same proportion of the weight of the beam itself must, however, be deducted as stated above for wood. Average steel 29 times as much as pine.

On this side of the dark lines, the safe loads of table. **Iron and Steel.**

much as $\frac{1}{480}$ of their clear span. Average cast iron, with the same safe def will bear about 11½ as much as common yellow or white pine, or spruce; and wrought iron 19 times as much. The same proportion of the weight of the beam itself must, however, be deducted as stated above for wood. Average steel 29 times as much as pine.

IMPORTANT.—When load is uniformly distributed over beam take 1.6 times above loads.

The average width of a shingle is four inches. Hence, when shingles are laid four inches to the weather each shingle averages 16 square inches, and 900 are required for a square of roofing (100 square feet). If $4\frac{1}{2}$ inches to the weather, 800; 5 inches, 720; $5\frac{1}{2}$ inches, 655; 6 inches, 600.

Slating.

FILE 695.2

Slating is estimated by the "square," which is the quantity required to cover 100 square feet. The slates are usually laid so that the third laps the first three inches.

Number of Slates per Square.

Size in Inches.	Pieces per Square.	Size in Inches.	Pieces per Square.	Size in Inches.	Pieces per Square.
6 × 12	533	8 × 16	277	12 × 20	141
7 × 12	457	9 × 16	246	14 × 20	121
8 × 12	400	10 × 16	221	11 × 20	137
9 × 12	355	9 × 18	213	12 × 22	126
7 × 14	374	10 × 18	192	14 × 22	108
8 × 14	327	12 × 18	160	12 × 24	114
9 × 14	291	10 × 20	169	14 × 24	98
10 × 14	261	11 × 20	154	16 × 24	86

The weight of slate per cubic foot is about 174 pounds, or per square foot of various thicknesses as follows:

Thickness in inches.....	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
Weight in pounds.....	1.81	2.71	3.62	5.43	7.25

Tin Roofs.

FILE 695.3

Tin roofs should be laid with cleats.

There are two kinds of tin—"bright tin," the coating of which is all tin, that is, the tin proper; and "tern," "leaded," or "roofing" tin, the coating of which is a composition, part tin and part lead. This last will not rust any quicker, but the sulphur in soft coal smoke eats through the "leaded" coating sooner than through the "tinned."

Sizes of tin, 10 by 14 and 14 by 20, and two grades of thickness—IC light, and IX, heavy. For a steep roof (one-sixth pitch or over) the IC 14 by 20 tin ("leaded" if high up where little smoke will get to it; "bright" if low down), put on with a standing groove, and with the cross seams put together with a double lock, makes as good a roof as can be made. For flat roofs IX 10 x 14 "light" is best, laid with cleats, but the others make good roofs and any of them will last twenty-five years at least, if painted periodically.

Number of Square Feet a Box of Roofing Tin Will Cover.—For flat seam roofing, using $\frac{1}{2}$ -inch locks, a box of "14 by 20" size will cover about 192 square feet, and for standing seam, using $\frac{3}{8}$ -inch locks and turning $1\frac{1}{4}$ and $1\frac{1}{2}$ inch edges, making 1-inch standing seams, it will lay about 168 square feet.

For flat seam roofing, using $\frac{1}{2}$ -inch locks, a box of "28 by 20" size will cover about 399 square feet, and for standing seam, using $\frac{3}{8}$ -inch locks and turning $1\frac{1}{4}$ and $1\frac{1}{2}$ inch edges, making 1-inch standing seams, it will lay about 365 square feet.

Every box of roofing plates (IC or IX "14 by 20" or "28 by 20" sizes) contains 112 sheets.

For roofs and gutters use seven-pound lead; for hips and ridges, six-pound; for flashings, four-pound.

Gutters should have a fall of at least one inch in ten feet.

No sheet lead should be laid in greater length than ten or twelve feet without a dip to allow for expansion.

Joints to lead pipes require a pound of solder for every inch in diameter.

Window glass being.....	1,000
Oak or Walnut	66
White Pine.....	80
Pitch "	100
Lath and Plaster.....	75 to 100
Brick (rough).....	200 to 250
" Whitewashed.....	200
Granite or Slate.....	250
Sheet Iron.....	1030 to 1110

Table Showing Amount of Glass Surface which may be Heated by 1 Square Foot of Radiating Surface in Good Buildings.

Temperature of radiating surface (radiators) Fahr	Hot Water.			Steam.	
	160°	180°	200°	227° 5 Lbs.	240° 10 Lbs.
Square Feet of Glass to 1 Square Foot Radiator Surface.					
Temperature above surrounding air 90°	1.9	2.3	2.8	3.3	3.8
" " " " 80°	2.3	2.9	3.5	4.0	4.6
" " " " 70°	3.0	3.6	4.2	5.0	5.7
" " " " 60°	4.0	4.6	5.25	6.0	7.0
" " " " 50°	5.0	6.0	6.8	8.0	9.0
" " " " 40°	6.9	8.0	8.2	10.0	11.5

Proportion of Parts of Steam Heating Boilers.

FILE 697.43

FROM PROF. R. C. CARPENTER.

Radiating surface=square feet.....	250	500	750	1000	1500	2000	3000	4000	5000	7500	10000
Nominal horse-power.....	2.5	5.0	7.5	10.0	15.0	20.0	30.0	40.0	50.0	75.0	100.0
Ratio radiating to heating surface.....	4.5	5.1	5.4	5.6	6.0	6.2	6.7	6.9	7.0 9.0*	7.0 9.0*	7.0 9.0*
Probable evaporation per lb. coal.....	5.5	5.7	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Pounds of steam per sq. ft. grate (A).....	55.0	57.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0	95.0	100.0
Pounds of steam per sq. ft. grate (B).....	44.0	46.0	48.0	52.0	56.0	60.0	64.0	68.0	72.0	76.0	80.0
Ratio radiating to grate surface (A).....	165.0	171.0	180.0	195.0	210.0	225.0	240.0	255.0	270.0	285.0	300.0
Ratio radiating to grate surface (B).....	132.0	138.0	144.0	156.0	168.0	180.0	192.0	204.0	216.0	228.0	240.0
Ratio heating to grate surface (A).....	36.5	33.2	33.2	34.8	35.0	36.2	36.5	37.0	38.5	40.5 31.5*	42.5 33.3*
Ratio heating to grate surface (B).....	28.5	27.0	26.7	27.7	28.0	29.0	29.3	29.6	30.8	32.2 25.2*	34.5 26.5*
Heating surface, square feet.....	55.0	98.0	138.0	178.0	250.0	322.0	447.0	580.0	710.0	1071 833*	1430 1111*
Grate surface, square feet (A).....	1.52	2.92	4.15	5.68	7.15	8.9	12.4	15.7	18.5	26.5	33.3
Grate surface, square feet (B).....	1.88	3.88	5.4	6.37	8.92	11.2	15.5	19.5	23.2	32.5	41.5
Diameter of safety valve, inches.....	1.5	2.25	2.50	2.75	3.0	3.25	3.5	4.2	4.0	2 of 3	2 of 4
Diameter of smoke flues, inches.....	7.0	10.0	11.2	12.0	15.0	17.0	19.0	23.0	25.0	28	3A
Square inches in above flues.....	38.5	78.5	95.0	113.0	176.7	227.0	283.5	415.5	490.9	615.7	907.9

* Water tube boilers.

A When rate of coal consumption is 10 pounds per hour each square foot grate surface.

B When rate of coal consumption is 8 pounds per hour each square foot grate surface.

In using steam for the heating of high buildings, it is necessary to use the overhead plan, unless some automatic system of expelling the air is adopted. It requires less power to force the air through the standpipe than it would through a large number of risers. The air is forced out on the descent of the steam, and less fuel and power are necessary.

The overhead hot-water system is coming into general use, as it can be put in so that the farthest radiators in a building will heat at the same time as those nearer the boiler, and the result will also be felt in rooms in the basement—the principle of the siphon causing the effect.

The pipes from the main in the attic, from which the several branches are taken, can be pitched so that heat in the several parts of a building will result as quickly as desired; either an open or closed tank can be used. The pipes exposed in attic should be covered. Opinions vary as to the sizes of pipe to be used.

List of Sizes of Steam Mains.

FILE 697.42

To determine the size of pipes no fixed rule can be given which will apply in all cases. A rule that has generally been accepted by steam fitters as good practice, is to allow the area of a one-inch pipe (.7854 square inches) for every 100 square feet of radiating surface, including mains.

Radiation.		One-pipe work.	Two-pipe work.
40 to	50 square feet.....	1 inch.....	$\frac{3}{4}$ x $\frac{3}{4}$ inch
100 to	125 square feet.....	$1\frac{1}{4}$ inch.....	1 x $\frac{3}{4}$ inch
125 to	250 square feet.....	$1\frac{1}{2}$ inch.....	$1\frac{1}{4}$ x 1 inch
250 to	400 square feet.....	2 inch.....	$1\frac{1}{2}$ x $1\frac{1}{4}$ inch
400 to	650 square feet.....	$2\frac{1}{2}$ inch.....	2 x $1\frac{1}{2}$ inch
650 to	900 square feet.....	3 inch.....	$2\frac{1}{2}$ x 2 inch
900 to	1,250 square feet.....	$3\frac{1}{2}$ inch.....	3 x $2\frac{1}{2}$ inch
1,250 to	1,600 square feet.....	4 inch.....	$3\frac{1}{2}$ x 3 inch
1,600 to	2,050 square feet.....	$4\frac{1}{2}$ inch.....	4 x $3\frac{1}{2}$ inch
2,050 to	2,500 square feet.....	5 inch.....	$4\frac{1}{2}$ x 4 inch
2,500 to	3,600 square feet.....	6 inch.....	5 x $4\frac{1}{2}$ inch
3,600 to	5,000 square feet.....	7 inch.....	6 x 5 inch
5,000 to	6,500 square feet.....	8 inch.....	7 x 6 inch
6,500 to	8,100 square feet.....	9 inch.....	8 x 6 inch
8,100 to	10,000 square feet.....	10 inch.....	9 x 6 inch

FILE 697.48

RULE FOR FINDING THE REQUIRED AREA FOR ANY CHIMNEY.

Multiply the nominal horse-power of the boiler by 112, and divide the product by the square root of the height of the chimney in feet. The quotient will be the required area in inches, at the top of chimney.

Table showing diameter and height of chimney for any boiler:

Horse-Power of Boiler.	Height of Chimney in feet.	Interior Diameter at top.	Horse-Power of Boiler.	Height of Chimney in feet.	Interior Diameter at top.
10	60	14 in.	70	120	30 in.
12	75	14 "	90	120	34 "
16	90	16 "	120	135	38 "
20	99	17 "	160	150	43 "
30	105	21 "	200	165	47 "
50	120	26 "	250	180	52 "
60	120	27 "	380	195	57 "

In forming the following named colors, mix as they come in order, the predominant being first; second, next; third, next, and so on:

Gray—use white lead and lampblack.

Buff—use white lead, yellow ochre and red.

Pearl—use white, black and blue.

Orange—use yellow and red.

Purple—use violet, red and white.

Gold—use white, stone ochre and red.

Olive—use yellow, blue, black and white.

Chestnut—use red, black and yellow.

Flesh—use white, yellow ochre and vermillion.

Limestone—use white, yellow ochre, black and red.

Fawn—use white, yellow and red.

Chocolate—use raw umber, red and black.

Drab—use white, raw and burnt umber; or, white, yellow ochre, red and black.

Bronze-Green—use chrome green, black and yellow; or, black and yellow; or, yellow, black and green.

Pea-Green—use white and chrome green.

Rose—Use white, madder and lake.

Copper—use red, yellow and black.

Lemon—use white and yellow.

Snuff—use yellow and vandyke brown.

Shingle Stains

FILE 698.4

Should contain a large amount of creosote for their base, and the highest grades of English ground colors, and the proper amount of fixative oil to make the colors durable and lasting. Stains are artistic colorings, and give an effect that can be got in no other way. Stains can be applied with a brush, as paint is, after the shingles are laid, or the shingles can be dipped in the stain. The coloring effect is about the same in either case, but the dipping preserves the shingles best.

Covering capacity, based on the regulation sawed cedar shingle, 4 by 16, is as follows: One brush coat, 1 gallon to 150 square feet of surface; two brush coats, 1 gallon to 100 square feet of surface; dipping, $2\frac{1}{2}$ gallons to $2\frac{3}{4}$ gallons to 1,000 shingles; dipping, and applying one brush coat after the shingles are laid, 3 gallons to 1,000 shingles. But two-thirds the length of the shingle need be dipped. When the roof-water is to be used for drinking, it should be turned off from the cistern until two or three hard rains have washed off the superfluous stain.

SOME PAINTER'S EXTRAS.

In estimating the painter's work, a few facts and data as to the quantity of paint required to cover certain areas of surface are necessary. Thus it is useful to know that 1 pound of mixed white lead paint will cover about $4\frac{1}{2}$ superficial yards the first coat, and about $6\frac{1}{2}$ yards each additional coat; that 1 pound of mixed red lead paint will cover about $5\frac{1}{4}$ yards super. of iron. Some authorities say 45 yards of first coat, including stopping, will require 5 pounds of white lead, 5 pounds of putty and 1 quart of oil; and 45 yards of each succeeding coat will require 5 pounds of white lead and 1 quart of oil. These quantities do not exactly agree, but they are approximately correct, and we may take about $6\frac{1}{2}$ to 7 yards to be about a fair allowance for 1 pound of paint.

It may be useful to remember that the decimal .27 multiplied by the rate of wages for a painter per hour will give the cost per yard for common work, including stopping, knotting, etc., and the decimal .15 for second and following coats.

The equal corresponding weight in the center of a girder caused by a certain ascertained weight coming at any other point of the same girder.

W = Known Weight.

L = The whole length between the bearings. /

D = Distance between resting point of W and the furthest support.

D' = Distance between resting point of W and the nearest support.

E = Half the distance between the supports.

x = The equal corresponding weight or strain in the center.

W E

Then $x = \frac{W E}{D}$

D

Example.—Let A B be a girder 12 ft. long with a girder resting on it 4 ft. from A with a known resultant weight of 5 tons, then x or strain at C (center)

$$= \frac{5 \times 6}{8} \text{ or } 3\frac{3}{4} \text{ tons.}$$

To resolve the weight W into the two concurrent parallel forces at A and B, or the resultant weight or strain at the bearings. Taking the above example.

$$\text{Strain at B} = \frac{W D'}{L} \text{ or } \frac{5 \times 4}{12} = 1\frac{2}{3} \text{ tons.} \quad \text{Strain at A} = \frac{W D}{L} \text{ or } \frac{5 \times 8}{12} \text{ or } 3\frac{1}{3} \text{ tons.}$$

When a beam is fixed at one end only, and has to support a weight uniformly distributed over the length the form of equal strength is a triangle, supposing the beam to be everywhere the same, but if the section of beam be circular, then the form of equal strength will be a semi-cubic parabola.

A cast iron girder if made too deep will be too rigid, and a comparatively small impulsive force will break it, the outline of the compressed side or top flange of a C. I. girder if to bear a weight uniformly distributed should be an arch the radius of which equals the square of half the length divided by the depth or

$$\left(\frac{L}{2} \right)^2 \div d \text{ where } L = \text{length of Girder between the bearings.}$$

d = depth of Girder.

If the depth is obliged to be uniform then the outline of the breadth should be formed by setting two parabolas base to base, their verticals being in the middle of the length.

I-BEAMS USED IN WALL FOUNDATIONS.

METHOD OF CALCULATION.

Let L=Weight of wall per lineal foot in tons

and b=Assumed bearing capacity of ground per square foot (usually from 1 to 3 tons);

L

then $\frac{L}{b}$ =W=Required width of foundation in feet.

b

w=Width of lowest course of footing-stones.

p=Projection of beams beyond masonry in feet.

s=Spacing of beams center to center in feet.

Evidently the size of beams required will depend upon their strength as cantilevers of a length "p" sustaining the upward reaction, which may be regarded as a uniformly distributed load.

Thus p b=uniformly distributed load (in tons) on cantilevers per lineal foot of wall

and p b s=uniform load in tons on each beam.

EXAMPLE.

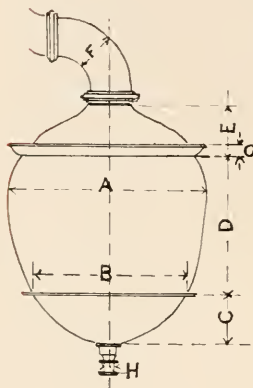
The weight of a brick wall together with the load it must support is 40 tons per lineal foot. The width of the lowest footing-course of masonry is 6 ft. Allowing a pressure of 2 tons per square foot on the foundation, what size and length of I-beams 18 in. center to center will be required?

Answer— $L=46$, $b=2$, $w=6$, $s=1\frac{1}{2}$.

Therefore $W=40 \div 2=20$ ft., the required length of beams. The projection "p"
 $=\frac{1}{2} (20-6)=7$ feet.

In order to apply the table (calculated for $s=1$ ft.) we must consider "b" increased
 in the same ratio as "s," i. e., $b=2 \times 1\frac{1}{2}=3$ tons.

In the column for 3 tons we find the length 7 ft. to agree with 20 in. I-beams 65.0
 lbs. per foot. See p 166 Carnegie Steel Co.



Memoranda for Breweries.
 Kettle Measures

Barrels	A	B	C	D	E	F	G	H
50	8' 6"	7' -	2' -	5' -	2' -	2' -	6"	3"
100	10' 6"	8' 6"	2' 6"	6' -	2' 6"	-	8"	4"
150	11' 6"	9' 3"	-	7' 6"	-	2' 6"	-	-
200	12' 6"	10' -	2' 10"	8' 6"	2' 10"	-	10"	5"
250	13' 6"	10' 6"	3' -	9' 6"	3' -	-	-	-
300	14' 6"	11' -	-	10' -	-	3' -	12"	-
350	15' -	11' -	3' 6"	10' 6"	4' -	-	-	-
400	16' -	12' -	4' -	11' -	-	-	-	-

Capacities for Appliances

Kettle	50 barrels	100 barrels	150 barrels	200 barrels	250 barrels	300 barrels	400 barrels
Mash-tub	11' x 5' -	12' x 6' -	14' x 6' -	15' x 6' 6"	16' x 6' -	17' x 7' -	18' x 7' -
Hop-jack	7' x 8' x 5'	8' x 9' x 6'	10' x 12' x 6'	11' x 14' x 6'	12' x 14' x 6' 6"	14' x 15' x 7'	14' x 15' x 6"
Meal hopper	8' x 4' x 4'	8' x 6' x 4'	9' x 7' x 6'	10' x 7' x 5'	10' x 8' x 5'	11' x 8' x 5' 6"	12' x 10' x 6'
Beer tank	8' x 6' x 5'	10' x 6'	12' x 6'	14' x 6'	15' x 6'	16' x 6' 6"	18' x 7'
Water tank	8' x 8' x 5' 6"	10' x 9' x 6' 5' 6"	12' x 9' x 7' 6"	13' x 10' x 8' 5' 6"	14' x 10' 6" x 8' 5' 6"	15' x 11' x 9' 6"	16' x 13' 6" x 8' 5' 6"
Band cooler	27 tubes 14' long	34 tubes 16' long	42 tubes 18' long	42 tubes 18' long	42 tubes 20' long	48 tubes 20' long	2 ea 42 tubes 18' long
Grain tank hopper	6' x 6' x 3' 6" 4' -	8' x 8' x 4' 6" 5' -	8' x 10' x 5' 5' 6"	10' x 10' x 5' 6" 5' 6"	10' x 12' x 6' 6' 6"	11' x 13' x 6' 6' 6"	12' x 15' x 7' 7' 6"

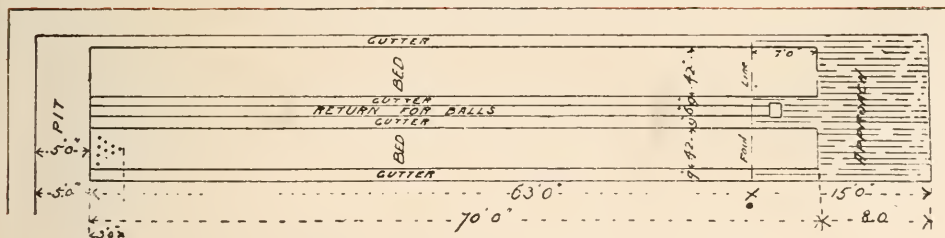
Size of the Billiard Room, Gas Light, Etc.

FILE 725.84

The space required for the different sized tables is as follows:

- For table 6 x 12.....Room should be 16 x 22
- For table 5½ x 11.....Room should be 15½ x 21
- For table 5 x 10.....Room should be 15 x 20
- For table 4½ x 9.....Room should be 14 x 18½
- For table 4 x 8.....Room should be 13 x 17
- For table 3½ x 7.....Room should be 12½ x 16

The following directions for arranging the lights over billiard tables will be
 found useful. The distance of the light from the floor should be about 6 feet 2
 inches. For a 5½ by 11 table, cross-arms 31 inches and long arms 62 inches. For a
 5 by 10 table, the cross-arms of the pendant should measure, from light to light, 28
 inches and the long arm 56 inches. For a 4½ by 9 table, cross-arms 25 inches and
 long arms 50 inches. For a 4 by 8 table, cross-arms 22 inches and long arms 44
 inches.



Important Points in Figuring Dimensions of a Stable.

FILE 728,942

The proper height and width of a stable door is not less than nine feet square. Width and height of vehicles is as follows:

	Height.		Length.	Width.	
	Ft.	In.	Ft.	Ft.	In.
Brougham	7	0	11	6	0
Rockaway	7	0	11	6	0
Victoria	7	6	12	6	0
Demi-coach	7	0	12	6	0
Phaeton	8	6	10	6	0
Berlin Coach	7	6	13	6	6
Landau	7	6	13	6	6
Double suspension victoria.....	8	0	13	7	0
Vis-a-vis	7	0	12	6	0
Body brake	9	0	11	7	0
Goddard phaeton	8	0	9	6	0
Stanhope	8	0	9	6	0
Buggy	9	0	9	6	0
Single trap	6	0	9	6	0
Mail coach	9	0	15	6	6
Omnibus	8	0	11	6	0

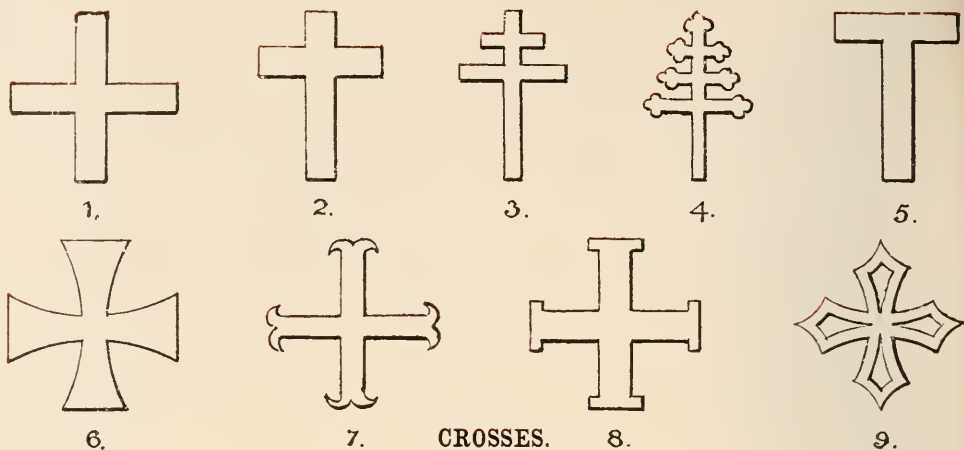
Spec. No.	No. of Stops.	From Back to Front Line of Case.	Width of Space Required.	Height Required for Swell-Box and Large Pipes.	Spec. No.	No. of Stops.	From Back to Front Line of Case.	Width of Space Required.	Height Required for Swell-Box and Large Pipes.
5	10	7' 4"	11' 6"	12' 6"	20	21	12' 9"	15' 6"	17'
7	11	8'	11' 6"	12' 6"	22	22	13' 4"	15' 6"	17'
8	12	8'	12' 6"	12' 6"	23	23	13' 6"	15' 6"	17'
10	13	8' 7"	12' 6"	12' 6"	25	24	14'	15' 6"	17'
11	14	9' 3"	12' 6"	12' 6"	26	25	14' 6"	15' 6"	17'
13	16	10' 5"	12' 6"	12' 6"	28	26	14' 6"	15' 6"	17'
14	17	11'	14' 8"	17'	29	27	14' 6"	16' 4"	17' 6"
16	18	11' 7"	14' 8"	17'	31	28	15'	16' 4"	17' 6"
17	19	12' 2"	14' 8"	17'	32	29	15' 6"	16' 4"	17' 6"
19	20	12' 9"	14' 8"	17'	34	30	15' 6"	17'	17' 6"

Add 40" more from Front Line of Case for Keydesk Pedals and Seat.

Sizes of Piano.

7 $\frac{1}{2}$ Octaves.

	Height.	Length.	Width.
Upright.....	about 4 ft. 3 in.	5 ft. 4 in.	2 ft. 3 in.
Small or Baby Grand.....	about 3 ft. 2 in.	6 ft. 0 in.	4 ft. 10 in.
Parlor Grand.....	about 3 ft. 2 in.	7 ft. 6 in.	5 ft. 0 in.



CROSSES.

FILE 726

The cross, a symbol of Christianity, has very naturally been extensively used in the monuments of the middle ages. When the two branches of the cross are equal in length, as in Fig. 1, the cross is called a Greek cross, and when the stem is longer than the arms, as in Fig. 2, it is a Roman or Latin cross. When the figure has two arms, one longer than the other, as in Fig. 3 (the upper one meant as a representation of the inscription which was placed over the head of Christ) it is known by the name of the Lorraine cross, and has received that name from its being a bearing in the arms of the Dukes of Lorraine. By heralds this is called a patriarchal cross. The next cross, whose arms are triple, as Fig. 4, is the papal cross, and is one of the emblems of the papacy, signifying, perhaps, like the triple crown or tiara, the triple sovereignty over the universal church, the suffering church and the triumphant church. The great majority of the western churches, with transepts, are constructed in the form of the Latin cross, those in the form of the Greek cross being very rare. Those in the form of the Lorraine cross are still rarer, and rarer are those constructed with triple transepts. There is another form called the truncated or tau cross, as Fig. 5, having the form of that letter, on which, as a plan, a few churches have been built. Considered as respects the contour, the cross in blason has been variously shaped and named. Thus, Fig. 6, in which the extremities widen as they recede from the center, is called a cross patee. This is met with more frequently than any of the others. It is seen in the nimbus, on tombs, on shields, upon coins, etc.; and is the usual form of the dedication cross found in religious structures. Fig. 7 is by the French called anree, the extremities forming hooks, but by heralds it is called the cross moline. Crosses flory are those in which the ends are formed into trefoils, as is seen in Fig. 4, the papal cross above mentioned. Fig. 8 is a cross potent, and Fig. 9 is the cross clechee, as respects the outer lines of its form: when it is voided, as shown by the inner lines, the ground or field is seen on which it lies.

SYMBOLS FOR THE APOSTLES.

From the constant occurrence of symbols in many cathedrals of the present day, the following list may be found useful:

PETER—Bears a key, or two keys with different wards. ANDREW—Leans on a cross so called from him; called by heralds the saltire. JOHN THE EVANGELIST—With a chalice, in which is a winged serpent. When this symbol is used, the eagle, another symbol of him, is never given. BARTHOLOMEW—With a flaying-knife. JAMES THE LESS—A fuller's staff bearing a small square banner. JAMES THE GREATER—A pilgrim's staff, hat, and escalop-shell. THOMAS—An arrow, or with a long staff. SIMON—A long saw. JUDE—A club. MATTHIAS—A hatchet. PHILIP—Leans on a spear or has a long cross in the shape of a T. MATTHEW—A knife or dagger. MARK—A winged lion. LUKE—A bull. ST. JOHN—An eagle. PAUL—An elevated sword or two swords in saltire. JOHN THE BAPTIST—An Agnus Dei. STEPHEN—With stones in his lap.

THE ORDERS AND THEIR APPLICATION.

FILE 729.3

PRACTICAL NOTES FOR ARCHITECTURAL DRAUGHTSMEN.

By ALFRED W. S. CROSS, M. A., F. R. I. B. A., and ALAN E. MUNBY, M. A.

Introduction.

So many scholarly works upon the Orders are in existence, that some explanation seems to be called for in introducing another series of articles upon a subject that is, to all appearances, already well worn.

Notwithstanding the consensus of opinion as to the general proportions that ought to be followed in their delineation, an opinion based upon the rules laid down by the architects of an early period of the Renaissance, a surprising divergence from the precepts and practices of these old masters of their art is to be found in many buildings of our own time.

The writers are only aware of the existence of one book which seems to meet the usual office requirements, and that is a work entitled: "Rules for drawing the several parts of Architecture," by James Gibbs, published in 1732; a book that has never been reprinted and copies of which are not now readily obtainable. The object aimed at, and successfully attained, is an illustration and description of an example of each Order, not "after Gibbs," but representing one of a good average type of design so proportioned that the dimensions of the various parts bear simple and easily discernible ratios one to another.

An attempt has been made to co-ordinate the leading features of the book by re-drawing some of the illustrations, retaining the useful dimensions shown thereon and entirely re-writing the description of the plates, with the introduction of some general principles likely to be of value to the draughtsman and student, for which purpose the opinions of standard writers, particularly those of Sir William Chambers, have been freely incorporated.

Before attempting such a condensation of the material in the book it was thought desirable to ascertain how far the generalizations adopted by it to give the results, as an indication of the actual value of the dimensions used.

The above examples have not been selected with any intention of justifying the proportions adopted by Gibbs, but are merely cited as those which readily occurred to the mind, or of which the dimensions could be easily obtained.

The result renders it evident that the general proportions of the Orders as recommended for adoption by this architect are fully worthy of confidence.

Hence, it would obviously seem preferable to master a few main dimensions, and, having thus inculcated a general sense of proportion, to rely upon gaining familiarity with the plates by constant use, when the proportions of the smaller members of the compositions will become naturally assimilated. The Composite Order is given in Gibbs' book, but, owing to its similarity to the Corinthian and to the absence of a consensus of opinion as to its dimensions, it has not been included in the present work.

No enrichments have been shown on any of the Orders to avoid distracting attention from the dimensions. With the exception of the whole of the Tuscan Order and of the frieze of the Ionic Order there are few members, apart from mere fillets, which have not been enriched, by some form of ornament, in one or another example, the Doric naturally the least and the Corinthian the most. In the latter Order, in fact, even the cyma and corona of the cornice, in addition to the frieze, ogees and beads, are often ornamented, but, apart from the question of expense, it is undesirable to carry such elaboration too far, as when placed in close contact with each other, especially when a distant view is alone possible, one moulding will often rob another of its effect, and, indeed, the value of richness of detail is more often than not lost in this manner.

The enrichment of columns beyond ordinary flutings is generally to be deprecated, while the

TABLE SHOWING THE APPROXIMATE RATIO BETWEEN THE LOWER DIAMETER OF THE COLUMN AND THE HEIGHT OF THE ENTABLATURE.

Tuscan.	Doric.	Ionic.	Corinthian.
Alberti 1:1.5	Alberti 1:2.0	Alberti {1:1.4}	Alberti 1:1.8
Palladio 1:1.8	Palladio 1:1.9	.. .. {1:1.7}	Palladio 1:2.0
Scamozzi 1:1.9	Scamozzi 1:2.1	Palladio 1:2.0	Scamozzi 2:2.0
Vignola 1:1.8	Vignola 1:2.0	Scamozzi 1:1.8	Vignola 1:2.5
—	Parthenon 1:2.0	Vignola 1:2.3	Pantheon 1:2.3
—	Baths, Diocletian 1:2.0	Fortuna (Rome) 1:2.3	Jupiter Stator .. 1:2.5
—	Temple Paestum 1:1.7	Baths, Diocletian 1:1.9	Jupiter Tonans .. 1:2.2
—	Apollo, Delos .. 1:1.8	Minerva, Athens 1:2.3	Temple Antonius 1:2.3
St. Paul's, Covent Garden 1:1.8	Bo w Church, Portico 1:1.9	Illius, Athens .. 1:2.3	Hampden Court 1:2.2
Average 1:1.76	Average 1:1.93	Average 1:2.00	Average 1:2.00
Gibbs 1:1.75	Gibbs 1:2.00	Gibbs 1:1.82	Gibbs 1:2.00

Gibbs really represent the proportions used by acknowledged authorities. For this purpose the average ratio of the diameter of the column to the height of the entablature, as being a relation which essentially affects the whole proportion of the Order, was obtained by measuring a number of recognized examples, and it may be of interest

application of ornament to bases and pedestals is seldom either requisite or desirable.

However great may be the utility of drawings dealing with the Orders, it should never be forgotten that they are merely a means to an end, that end being an executed building. Those whose

work is confined to a drawing board develop a strong tendency to consider their compositions solely from an elevational and artistic draughtsman's point of view, and every opportunity should be taken of checking this habit and of cultivating the art of thinking "in the round." The study of perspective of buildings, and, best of all, the preparation of models of portions of a proposed building, an occupation which often results in the discovery of latent defects of design, are alike of the greatest educational value to the student of architecture.

THE SETTING UP OF AN ORDER.

(To be studied in connection with Plates I., II., III., IV. and V.)

The sequence followed in setting up an Order will be found to influence, to some extent, the rapidity and facility with which it can be accomplished. An outline of the method of procedure may, therefore, prove useful.

Usually the height of the Order is fixed by circumstances, as, for example, when it is to be applied to a given storey of a building.

The total height having been settled, draw the limiting horizontal lines and then set out the vertical centre lines of the columns, thus dividing the frontage to be treated into bays appropriate to the exigencies of the design and having due regard to the correct intercolumniation of the Order adopted. If a pedestal is to be placed under the column, cut off one-fifth of the total height for it, and cut off one-fifth or one-sixth of the remainder (measured from the top limiting horizontal line) for the vertical height of the entablature; the intervening space gives the height of the column, including its cap and base. If no pedestal is to be used, divide the whole of the given height into five or six parts, cut off one of these parts, from the top, for the entablature, and the remainder gives the height of the column.

The Column. Since some of the dimensions of the entablature are in terms of the diameter of the column, the latter should be next developed. The term "diameter of the column" refers always to its greatest diameter—namely, that of the shaft just above the lower cincture. This dimension is one-seventh to one-tenth of the height between the soffit of the entablature and the top of the pedestal, or lower limit of the Order in the absence of a pedestal. If the centre lines of the piers do not represent the centres of the columns, as, for instance, when coupled columns are used, the centre line of one of the columns must now be decided upon and the diameter of the Order symmetrically disposed horizontally across it. A semi-diameter is then cut off, from the bottom of the column, for the height of the base, and it should be noticed that this—except in the Tuscan and alternative Doric Orders—does not include the fillet at the base of the shaft, the members above the upper torus being reckoned as part of the shaft, as are also the astragal and fillet below the necking of the capital of the column. The plinth and lower torus of the base project one-third and the upper torus one-fifth of a semi-diameter beyond the lower circumference of the shaft. The leading lines for the base having thus been obtained, cut off by a horizontal line the height of the capital from the top of the column, and (except in the Ionic Order) again below it, a height equal to one-sixth of a semi-diameter for the astragal and fillet below the necking.

The semi-diameter of the shaft at one-third of its height from the bottom is then divided into five or six parts, and four or five of these parts are taken as a semi-diameter at the top, below the astragal. The shaft may now be completed, the entasis being usually made to start from the greater diameter, one-

third up the shaft, below which point it is a true cylinder until the cincture at the base is reached. This is the best method to adopt in the case of small scale drawings. Where large detailed drawings are in question the diameter may be alternatively divided at the base of the shaft instead of at one-third of its height, and the entasis extended throughout the whole length. The completion of the shaft enables the projection of the capital to be marked off, and also that of the astragal and fillet, which is equal to their combined height.

The Entablature. The development of the entablature can now be proceeded with, the architrave, frieze and cornice being ruled off horizontally and the members of each inserted (see dimensions). The projections for a returned end or section are obtained from the upper diameter of the shaft. The lowest member of the architrave, and also the frieze, lie vertically over the circumference of this upper end of the shaft. The projection of the cornice beyond the frieze line is equal to its height, except in the Doric Order, in which the projection is one-third more than its height of one diameter. Further rules dealing with minor projections and the position of the modillions, dentils, etc., will be supplied by a study of the plates and tabulated dimensions.

Pedestal. Finally, the pedestal, if any, should be divided vertically into four parts; the lower part is ruled off for the height of the plinth, one-third of the second part for the height of the base, and one-half of the top part for that of the cap. The projection of the die is equal to that of the base of the column, and the plinth and the cap of the pedestal extends beyond this for a distance equal to the height of the base of the pedestal previously obtained.

The above dimensions will all be found in the subjoined table, which represents an endeavour to bring together, in a form suitable for reference, sufficient information to make any glaring disproportion impossible.

A few of the minor divisions are only approximations; they will, however, be found to be sufficiently accurate for any but large detail drawings, in which it is not desirable to destroy all individuality by rigorous mechanical rules.

On the left hand will be found the dimension required and, in the intermediate column the fraction for each Order of the previously ascertained unit given in the right-hand column.

Plate I.

Plate I. represents the four Orders drawn to a common vertical height.

The pedestal may or may not be required and, if used, it is to be regarded as an addition to the Order, the relative dimensions of the parts of which are not altered by its removal or introduction.

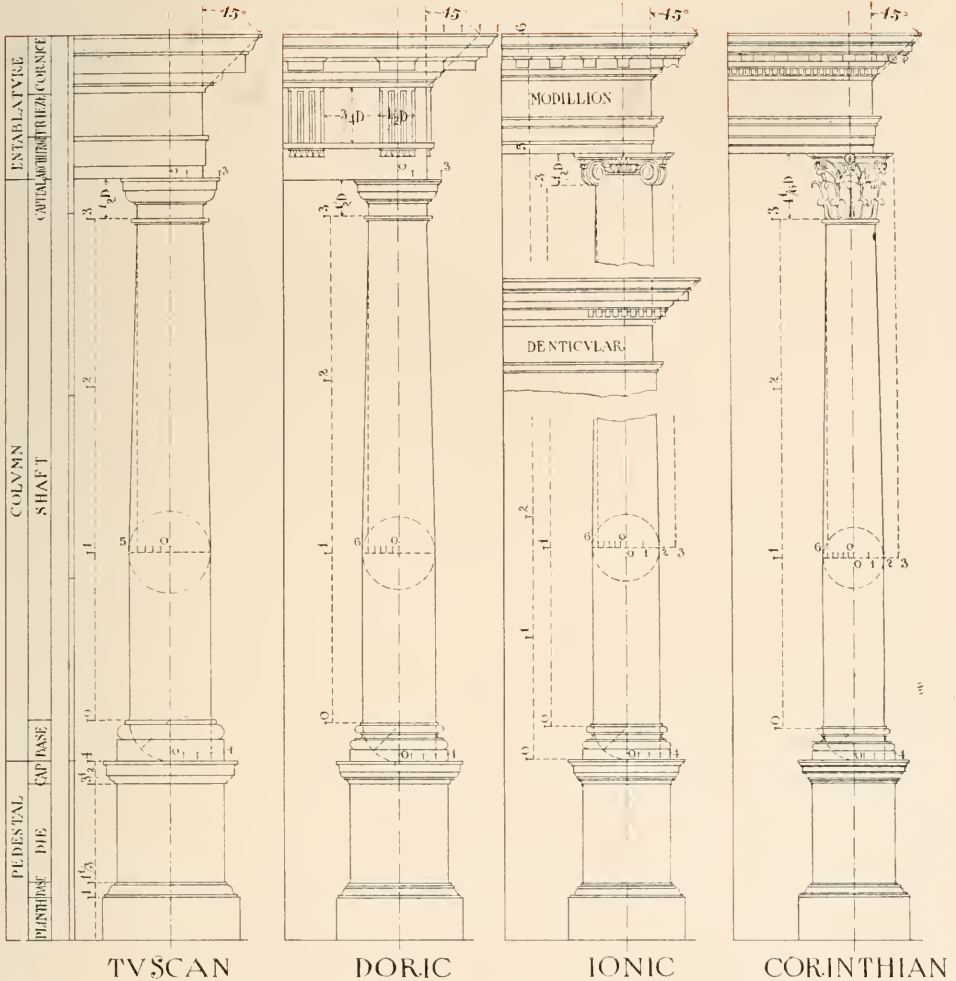
The diameter of the column (by which is meant the diameter of the shaft following its lower cincture) is the ruling dimension from which most of the others are obtained, and the smaller circumference of the top of the shaft always coincides with the frieze line from which all the projections of the entablature are set out.

In judging the value of such projections it should be borne in mind that in execution the higher vertical faces of the composition will usually be much foreshortened to the observer and that there will be a consequent increase in the comparative value of neighboring projections.

A perusal of the table will indicate those dimensions which all the Orders have in common, but for convenience of reference they are further summarized thus:

Height of Pedestal, $\frac{1}{5}$ total height of Order.

PLATE I.



TUSCAN

DORIC

IONIC

CORINTHIAN

- Height of Plinth, $\frac{1}{4}$ height of Pedestal.
- Height of Pedestal Base, $\frac{1}{3}$ height of Pedestal Plinth.
- Height of Pedestal Cap, $\frac{1}{2}$ height of Pedestal Plinth.
- Projection of Cap and Plinth, $\frac{1}{3}$ height of Pedestal Plinth.
- Projection of Corona over Die, $\frac{3}{4}$ projection of Pedestal Cap.
- Height of Column Base, $\frac{1}{2}$ diameter of Column.
- Projection of Base over Shaft, $\frac{1}{3}$ semi-diameter of Column.

Pilasters. The general proportions allotted to the columns of the Orders apply also to pilasters, which may be regarded as columns square on plan, but almost universally deeply engaged. The projection of pilasters must be regulated by circumstances. If impost mouldings or other projections stop upon them, as on the inner wall of an arcade, these projections must be sufficient to take the mouldings, and if they line with engaged columns crowned by an entablature, they must have a projection similar to the columns, and therefore in such cases never less than a semi-diameter. Apart from these

considerations, the projection should be about one-fourth of the diameter. Pilasters may be fluted or plain; if the former, the flutes should be, as far as possible, the same size as those of the adjoining columns, and always an odd number.

* * *

On plain faces 7 flutes (occasionally 9) are used, and therefore in the above case 1 flutes (or 5) would be employed on each side of the re-entering angle. The returned sides of pilasters should never be fluted unless the projection is as much as half of a diameter. The diameter assigned to a pilaster will be that of a column (if any) used in conjunction with it. The shaft may or may not be diminished.

If the pilaster stand alone it is best formed with the same top and bottom diameter, but if a column stand in front of it then it should be diminished to the same extent as the column. Entasis is not usually given to pilasters.

Unless columns and pilasters are monoliths the shafts should be built up of three drums and not two, as a central joint, unless exceptionally well executed, has a very disagreeable appearance.

"Practical Notes for Architectural Draughtsmen: The Orders and their Application,"
Tabulated Dimensions of the Orders. Arranged Progressively as Required for Use.

Dimension required.				Tuscan.	Doric.	Ionic.	Corinthian.	Dimension \pm 1.
No Pedestal	Height of Entablature	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Total height of Order.
With Pedestal	Height of Pedestal	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " less Pedestal.
THE COLUMN.								
Height of Shaft	Height of Base	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Order less Entablature and Pedestal.
" " " "	Base Plinth	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Diameter of Shaft.
" " " "	Lower Torus	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " less Plinth.
" " " "	Upper Torus	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " lower Torus.
" " " "	Upper Torus and fillet under Capital	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
" " " "	Necking	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Diameter of Shaft.
" " " "	Top of Neck to top of Ovolo	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Capital (Corinthian less Abacus).
" " " "	Abacus	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " " "
" " " "	Astragal and fillet	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " " "
" " " "	Fillet below Astragal	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Semi-diameter of Shaft.
Projection of Base beyond Diameter	Upper Torus	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Astragal and Fillet.
Diminution of Shaft at Top	Projection of Cap over Shaft at Top	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Semi-diameter of Shaft.
Projection of Cap over Shaft at Base	Cap over Shaft at Base	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
" " " "	Read at top of Shaft	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Semi-diameter of Shaft at Top.
THE ENTABLATURE.								
Height of Architrave	Frieze	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Entablature.
" " " "	Cornice	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
" " " "	Fillet and Cyma	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
" " " "	Corona and Fillet over Base of Corona to top of Ovolo	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
" " " "	Top of Ovolo to Frieze	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
Total projection of Architrave over top diam. of Shaft	top face of Architrave	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Architrave.
" " " "	of Cornice over Frieze	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Total projection of Architrave.
" " " "	Inset of Corona from top of Cornice	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Cornice.
" " " "	Length of Modillions (or Mutules)	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " "
" " " "	Breadth of Modillions (or Dentils)	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Fillet and Cyma of Cornice.
" " " "	Space between Modillions (or Dentils)	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Diameter of Column.
THE PEDESTAL.								
Height of Plinth	Base	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Pedestal.
" " " "	Cyma of Base	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " Plinth.
" " " "	Fillet below Cyma	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " Base.
" " " "	Cap	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Fillet above Cyma.
" " " "	Base of Corona to top of Cap	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Height of Plinth.
Projection of Cap and Plinth over Die	Projection of Cap over Die	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Cap.
" " " "	Projection of Cap over Die	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	" " " Base of Pedestal.
" " " "	Projection of Cap over Die	.	.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	Projection of Cap over Die.

Note. The "Diameter" is always the greatest diameter of the drum of the Column. M. refers to the Modillion Cornice. D. to the alternative Dentil Cornice.

PLATE 2.

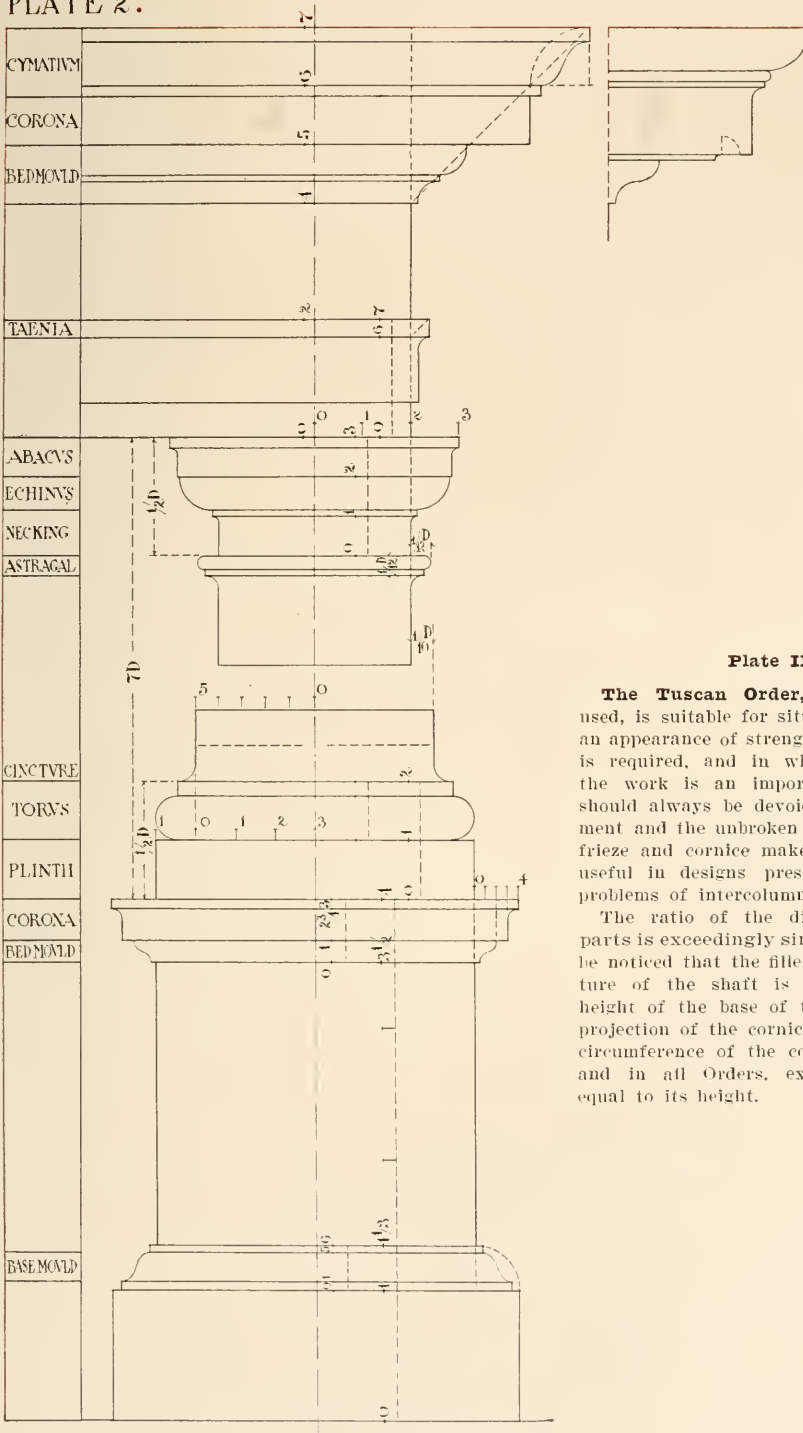


Plate II.

The Tuscan Order, though seldom used, is suitable for situations in which an appearance of strength and simplicity is required, and in which the cost of the work is an important factor. It should always be devoid of any enrichment and the unbroken character of the frieze and cornice makes it particularly useful in designs presenting awkward problems of intercolumniation.

The ratio of the dimensions of its parts is exceedingly simple. It should be noticed that the fillet below the cincture of the shaft is included in the height of the base of this Order. The projection of the cornice over the upper circumference of the column is, in this and in all Orders, except the Doric, equal to its height.

TUSCAN

PLATE 3. MUTULE CORNICE

DENTICULAR CORNICE

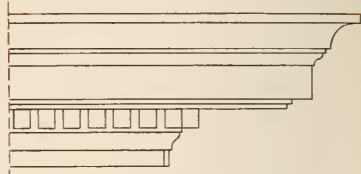
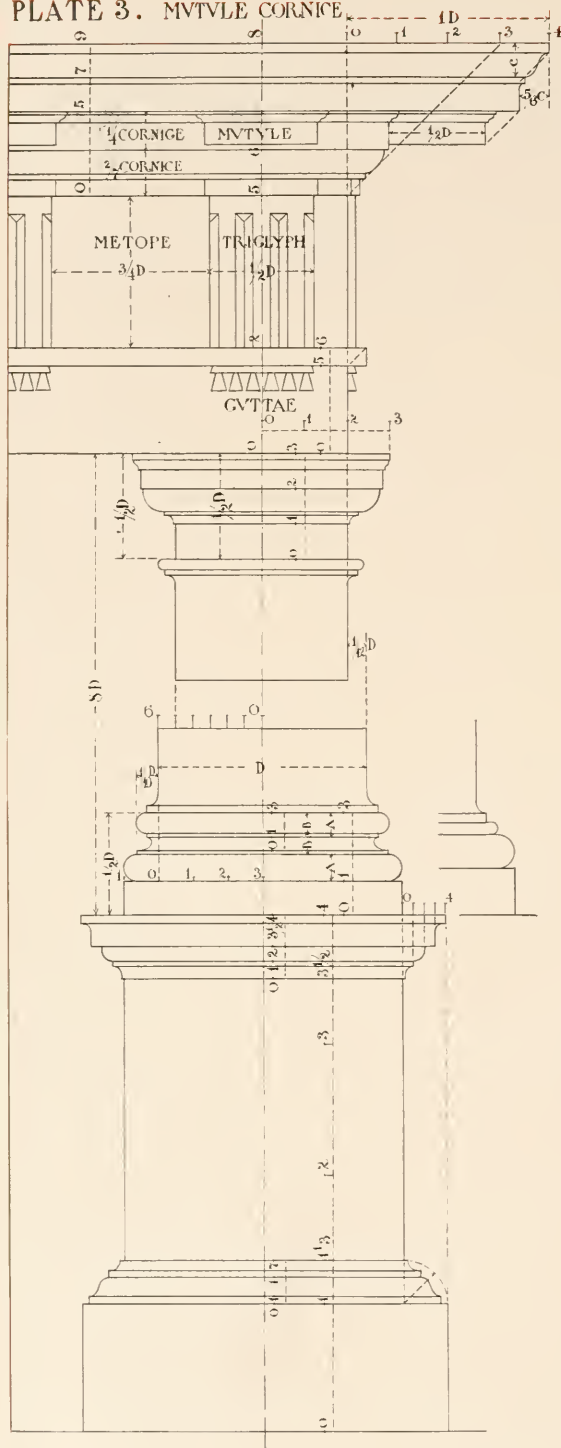


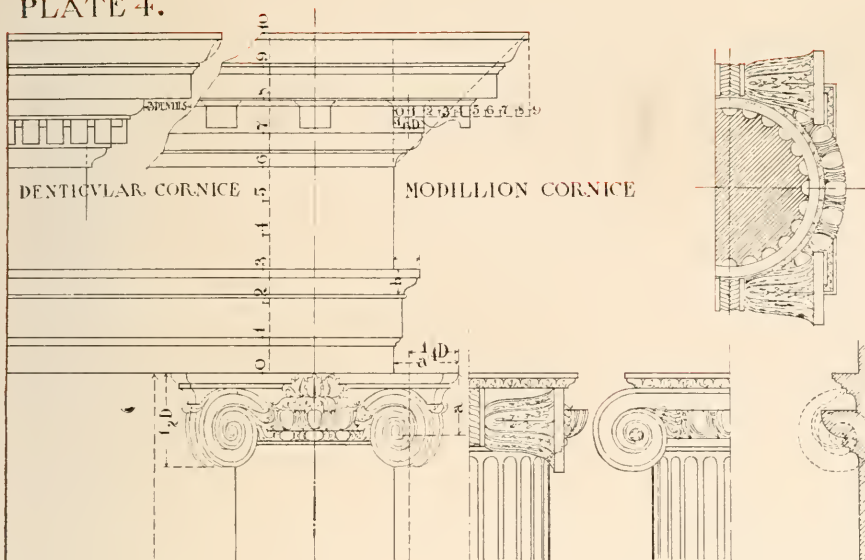
Plate III.

The Doric Order is always effective when used in lower storeys, arcades, and door and window openings, but owing to the triglyphs upon the frieze, which must fall centrally over the columns, it is the most difficult to deal with when spacing is in question.

The dimensions of the cornice do not lend themselves to any simple ratio and its projection is always greater than that adopted for the other Orders. The 45° line from the top of the frieze at once gives the bed mould of the mutule course, and one-third of the height of the cornice added to the top projection of this guiding line gives the total projection, while the mutules are one-half a diameter in side elevation. Some considerable modifications of the Order, as here represented, will be found to exist in many recognised examples. Occasionally the mutules are dispensed with, and their bed mould is cut to form a dentil course, as in the Theatre of Marcellus. The cyma crowning the cornice is often replaced by a cavetto, while the Doric base (shown alternatively on the plate) sometimes replaces the more graceful attic base. When this base is used, the upper fillet should be included in the height of the base, as in the Tuscan Order.

DORIC

PLATE 4.



CVSHION CAPITAL

Plate IV.

The Ionic Order shows smaller variations from the pure Classic examples than any other, and its proportions are fairly simple.

Two styles of cornices are, however, used, the modillion and the dentil cornice, and although the method adopted by Gibbs of giving prominence to the former has been followed, it should be stated that the latter is more generally found in old examples, whilst the former is preferred by Palladio.

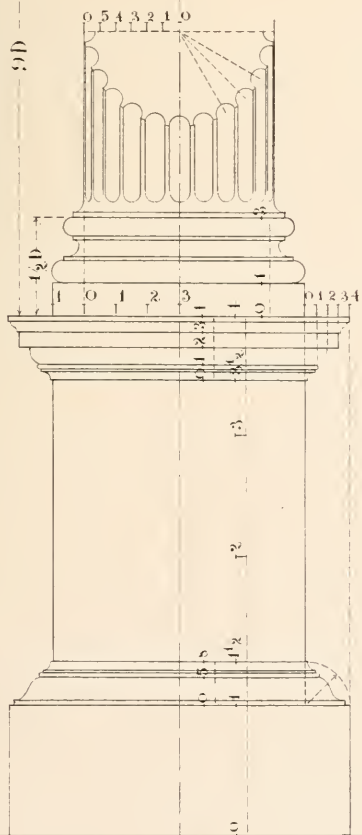
Represented side by side upon the plate the extent of the variation is easily discernible. A modillion or dentil should always be bisected by the centre line of the column and the spacing determined by the distance of this line from the frieze, as set out upon the drawing. The frieze is always plain and in larger works it is, preferably, kept flat. In smaller compositions, however, when narrow or when used over doors and windows a pulvinated frieze may be adopted with good effect.

The earlier alternative form of the Ionic capital in which the faces of the volutes are parallel to the plane of the elevation (not shown upon the drawings) may, of course, be substituted for the capital with angle volutes at 45°, though the latter has usually a much more graceful effect, particularly in small compositions. Of course, the geometrical method for setting out the volutes cannot be used in drawing such capitals in ordinary elevation. It should be noticed that the height of the capital in this Order is measured from the soffit of the volutes.

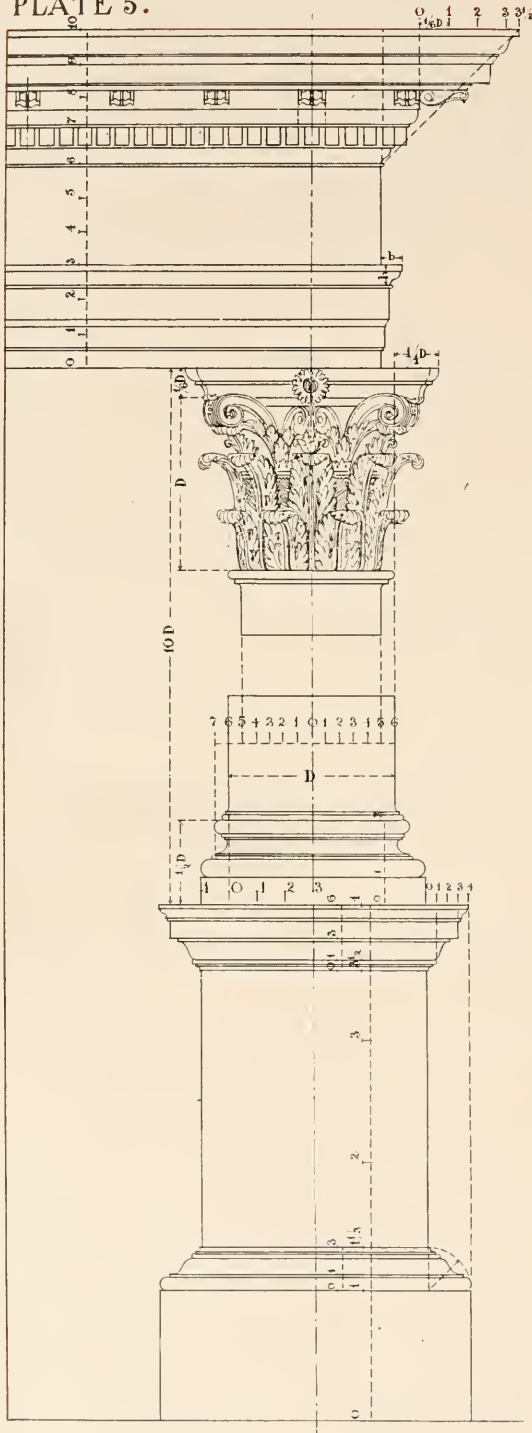
The centre of the eye is one third of the height of the capital from its bottom and is in elevation placed just outside the top circumference of the shaft, while the horizontal fillet at the top of the shaft is immediately below the eye.

When the column is fluted the width of the fillets should be one-fourth to one-third that of the flutes. The flutes generally number twenty or twenty-four; in the latter case the simple method of setting them out on plan, as shown on the drawing, will be found of service.

The attic base is always used with the Ionic Order.



IONIC



CORINTHIAN

Plate V.

The Corinthian Order has been represented with considerable variations from the original type.

The Ionic entablature was often used by the ancients, supported by Corinthian columns, and the Corinthian cornice itself, though here represented with a dentil band, is often found without one. No general rule appears to exist for spacing the modillions or for their dimensions, the ratio of the width of the modillion to the space between two of them varying from 1 : 1½ to 1 : 2½, and again the number of the dentils between the modillions varies from 2 to 5 in different examples.

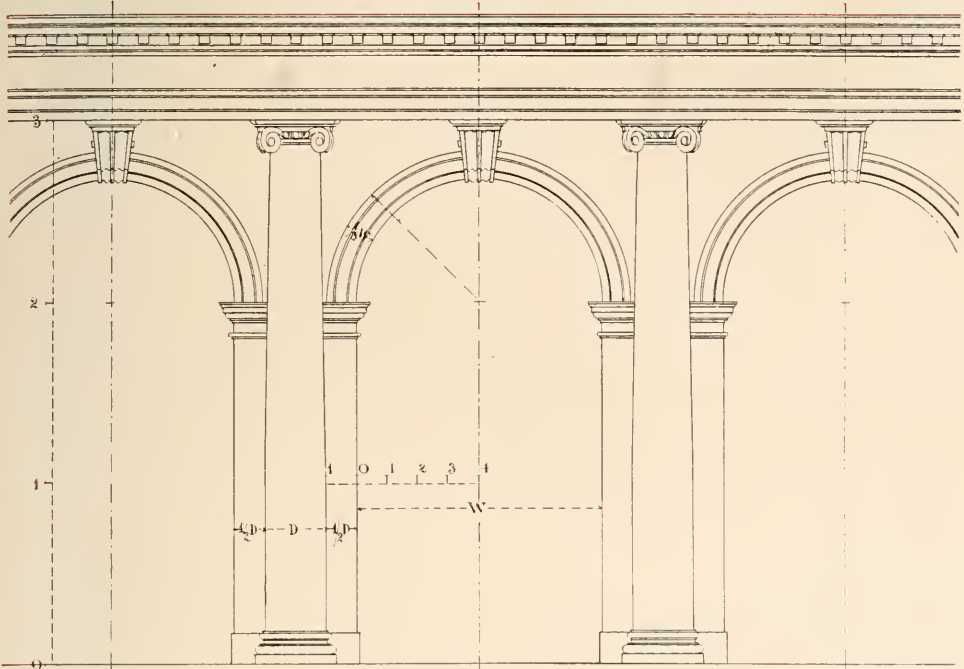
Both features should be symmetrically placed with reference to one another and to the centre line of the column, a point often neglected. To secure this result the following method is recommended :— Draw a modillion one-sixth of the diameter of the column in width, arranged symmetrically over the centre line of the column. Place another with its outside edge three and a half times its width within the total projection of the cornice, and thus obtain the spacing between the blocks. Divide the distance between two modillion centres into 15 parts, give two to a dentil, to be placed symmetrically under a modillion, and one to each space between the dentils, which will be found to bring the inside edge of the last dentil before the return, on the frieze line.

The form and projection of the leaves of the capital are largely matters of individual taste, but the general method of their arrangement will be evident after examining the drawing. It may, however, be noted that the eye of the volute is just outside the lower circumference of the shaft, and that the tiers of leaves divide the capital below the abacus into three approximate equal horizontal sections.

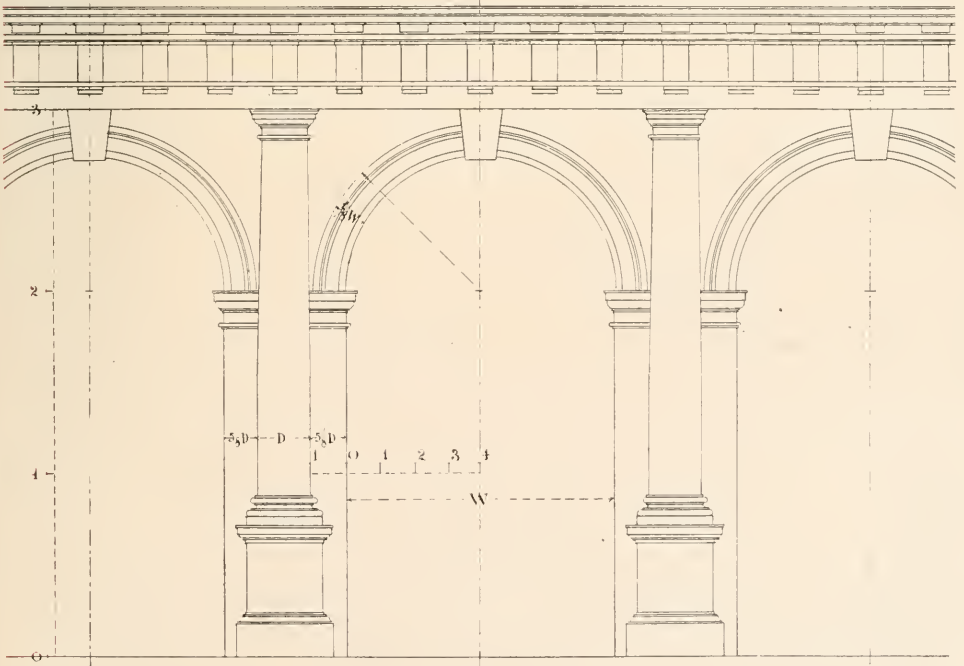
The column may or may not be fluted as in the Ionic Order.

The attic base, as used in the Ionic Order, is very generally employed—in fact, it is often preferable to adopt it, omitting the additional mouldings shown, for the sake of variety, on the drawing.

PLATE 6.



IONIC



DORIC

Plate VI.

The relations and dimensions given in this and similar subsequent plates must, therefore, be looked upon as necessarily somewhat elastic. At the same time, such dimensions as are given should not be disregarded, but considered in the light of proportions to be attained as far as the exigencies of the plan will admit.

The spacing of arcading dealt with in this plate should be governed by the height of the space to be treated, and it will be found that the best effects are obtained when the widths of the

seen that a relation exists between the diameter of the column, the width of the pilaster, and the width of the opening. Again, the diameter of the column relatively to the opening will be influenced by the presence, or absence, of a pedestal to the Order. The summary shown, collected from Gibbs's work, giving the dimensions to be aimed at in order to comply with the above relations, will be found useful.

The height of the impost should always be about two-thirds of the height from the ground to the soffit of the architrave of the Order, whether a pedestal is in use or not.

Diameter of Column = 1.

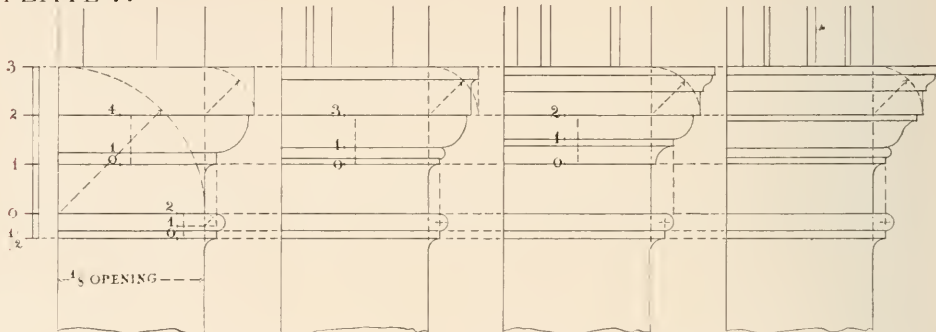
	Tuscan.		Doric.		Ionic.		Corinthian.	
	No Ped.	With Ped.	No Ped.	With Ped.	No Ped.	With Ped.	No Ped.	With Ped.
Width of bay centre to center	6	7	6 1/4	7 1/2	6	7 1/2	6 5-12	8 1/4
Width of one pilaster	1/2	2/3	1/2	5/8	1/2	5/8	3/8	7-10
Width of opening	4	4 2/3	4 1/4	5 1/4	4	5 1/4	4 1/8	5 3/8

openings approximate to half of their height, and when the total width of the piers lies between one-half and two-thirds of that of the opening.

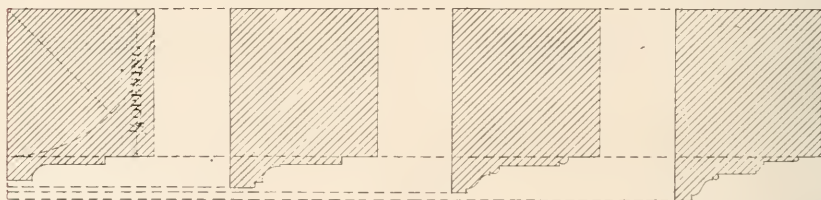
The spacing must also be considered in reference to the Order employed, so that when triglyphs, or modillions, are placed centrally over the columns their proper spacing may be interfered with as little as possible. It will thus be

The archivolt or moulding running round the arch should be the same width as the pilaster (less any necessary clearance for the mouldings) —that is, about one-eighth of the width of the opening, which should also be the height of the impost cap to the bottom of the necking. Further details as to the members will be found on Plate VII.

PLATE 7.



IMPOSTS AND ARCH MOVLDS



TUSCAN

DORIC

IONIC

CORINTHIAN

Plate VII.

Impost Mouldings.

Details are here given of impost mouldings, with their archivolts, suitable for the different Orders. The divisions of the imposts are all simple and similar in each example, the height of the corona and of its mouldings above, if any, being equal to the height of the mouldings below, which, again, are equal to the necking. The bead and fillet below the necking are one-sixth of the height of the impost, the bead being double the height of the fillet. The projection of the impost beyond the line of the pilaster is equal to the height of the corona and member over in the

first two Orders, while the projection of the corona itself is equal to this height in the last two.

The pilaster is square on plan, and, therefore, the plan of the archivolt is represented by this square upon which the mouldings are placed. An examination of these mouldings will show that they resemble the architraves given for their respective Orders, and their forms admit of similar variations. It will be noticed that the innermost face is always in the plane of the face of the pilaster, while the projection of the moulding at the extrados increases from about one-quarter the width of the whole archivolt in the Tuscan to one-third in the Corinthian Order.

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SUBJECT INDEX.

System of Classification for Filing Data, Drawings, Plates,
Catalogues, Etc., in Architects' Offices.

INTRODUCTION.

The decimal system of classification was devised and elaborated by Mr. Melvil Dewey, formerly director of the New York State Library. This system was intended primarily for the use of librarians in the classification and arrangement of books and pamphlets, but it was soon found that the system furnished also a simple and effective means of classifying, indexing and filing literary matter of all kinds. Engineers have found it useful for indexing technical data and information, catalogs, reports, card systems, drawings, etc., and it has been found equally useful by manufacturing and business concerns.

Much of the following information is taken from the University of Illinois Engineering Experiment Station, Bulletin No. 9, prepared by L. P. Breckenridge, Professor of Mechanical Engineering, and G. A. Goodenough, Associate Professor of Mechanical Engineering.

EXPLANATION OF THE DECIMAL SYSTEM.

The essential characteristic of the Dewey System is its method of division and sub-division. The entire field of knowledge is divided into nine chief classes numbered by the digits from 1 to 9. Matter of too general a nature to be included in any of these classes is put into a tenth class and indicated by 0. The following are the primary classes of the Dewey System:

- 0 GENERAL WORKS
- 1 PHILOSOPHY
- 2 RELIGION
- 3 SOCIOLOGY
- 4 PHILOLOGY
- 5 NATURAL SCIENCE
- 6 USEFUL ARTS
- 7 FINE ARTS
- 8 LITERATURE
- 9 HISTORY

Each of these classes is again divided into nine divisions, with a tenth division for general matter, and each division is separated into nine sections. The sections are again sub-divided and the process may be carried as far as desired.

It is thought that this system will be especially valuable to architects for classifying drawings, catalogs, reports and technical data. Our space is too limited to publish the complete work, nor is it desirable. Should any one be sufficiently interested to go into the matter thoroughly, they should have Mr. Dewey's complete text on the subject. In order to make the application of the system clear in the briefest possible way, the miscellaneous information contained in this book has been assumed to comprise a small architect's library and has been classified according to the Dewey System. It is hoped that this will make clear the practical application to architects' libraries, both large and small. In succeeding years, we hope to be able to publish a more extensive relative index in which the items of the classification are arranged alphabetically, the one at present published only covering the items of miscellaneous information contained in this book, with some of the more important general topics. We are particularly concerned as practitioners of the profession of architecture with divisions 6 and 7, "Useful Arts" and "Fine Arts," comprising the following subject numbers:

600 USEFUL ARTS

- 610 MEDICINE
- 620 ENGINEERING
- 630 AGRICULTURE
- 640 DOMESTIC ECONOMY
- 650 COMMUNICATION AND COMMERCE.
- 660 CHEMICAL TECHNOLOGY
- 670 MANUFACTURES
- 680 MECHANIC TRADES
- 690 BUILDING

Omitting all sub-divisions of this topic, with the exception of 690 "Building," we publish the sub-divisions of same. As distinguished from **Architectural Construction**, "Building" has to do more particularly with the processes of construction and matters pertaining to trades and materials involved in the construction of buildings should be more properly classified under "Building", while matters as to types and component architectural parts are more properly classified under **Architectural Construction**.

690. BUILDING. For Archt. Const., see 721.

- .1 Theories of Construction; .2, Compends, Manuals; .3, Dictionaries, Cyclopedias; .4, Essays, Lectures; .5, Periodicals; .6, Societies, Exhibitions; .7, Education, Study, Training, Apprenticeship, Tools and their Use (for the use of special tools see special trade); .8, Collections, Patents, Inventions; .9, History of Building Construction.

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For use of Proper Materials, see 693 to 699.

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- .12 Preservatives of, arranged alphabetically.
- .2 **NATURAL STONE.**
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- .22 Preservatives of, arranged alphabetically.
- .3 **ARTIFICIAL STONE AND CONCRETE.**
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- .32 Preservatives of, arranged alphabetically.
- .4 **BURNED CLAY PRODUCTS.**
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- .42 **Structural Tile.**
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INDEX TO BUILDING ORDINANCE.

(See Pages 65 to 177.)

NOTE:—In this index, matters relating to Officers, Appointments, Etc., come first, then the Classes from I to VIII, and lastly the General Provisions, each alphabetically arranged under their respective headings.

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Advertisers are classified with a view to furnish Architects and others a ready reference list of houses engaged in the Building Business. It is requested that those using it will kindly mention this book in their correspondence.

AIR COMPRESSORS.

Contractors Supply & Equipment Co., Old Colony Bldg.
Fairbanks, Morse & Co., Franklin and Monroe.
Scully Steel & Iron Co., Halsted and Fulton.

AIR PURIFYING APPARATUS.

Thomas & Smith, 17-19 S. Carpenter St.

AIR VALVES.

Davis, G. M. Regulator Co., 144-146 Milwaukee Av.

ALTAR AND CHURCH FURNITURE

Andrews, A. H. Co., The, 174-176 Wabash.

AMMONIA FITTINGS.

Creamery Package Mfg. Co., The, 184 Kinzie St.

Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Bldg., Chicago.

Wolf, Fred W. Co., The, 139 Rees St.
York Mfg. Co., 1060 Monadnock Block.

ANDIRONS AND FIREPLACE FURNISHINGS.

Dawson Bros., 197-207 N. Halsted St.

ANGLES AND CHANNELS.

Bolters, A. Sons, 84 La Salle St.
Butler Street Foundry & Iron Co., 3422-32 Butler St.

Holmes, Pyott & Co., 13 N. Jefferson St.
Illinois Steel Company, 50 Wabansia Av.
Morava Construction Co., 1243 Marquette Bldg.

Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Scully Steel & Iron Co., Halsted & Fulton Sts.
South Halsted St. Iron Works, 135 Adams St.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.

Voss, Frederick, 617 to 621 Austin Av.

ARCHITECTS' SUPPLIES.

Abbott, A. H. & Co., 151-153 Wabash Av.
Dietzen, Eugene Co., 181 Monroe St.
Keuffel & Esser Co., 111 Madison St.

ARCHITECTURAL AND STRUCTURAL IRON AND STEEL.

Bolters, A. Sons, 84 La Salle St.
Butler Street Foundry & Iron Co., 3422-32 Butler St.

Central Iron Works of Chicago, 263-265 West Lake St.

Eastern Metal Works, 780 W. Chicago Av.
Halsted, Joseph, Co., 388 W. Randolph St.
Holmes, Pyott & Co., 13 N. Jefferson St.
Illinois Steel Company, 50 Wabansia Av.
Jackson, George W., Inc., 169-179 W. Jackson Blvd.

Kenwood Bridge Co., First Nat'l Bank Bldg.
Morava Construction Co., 1243 Marquette Bldg.,
Muth, Chr., 428 Blue Island Av.

Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Scully Steel & Iron Co., Halsted & Fulton Sts.
Smith, F. P. Wire & Iron Works, 100 Lake St.
South Halsted St. Iron Works, 135 Adams St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.

Standard Company, The, 810 Ry. Exchange.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.

Voss, Frederick, 617 to 621 Austin Av.

ARCHITECTURAL IRON WORK.

Bolters, A. Sons, 84 La Salle St.
Eastern Metal Works, 780 W. Chicago Av.
Halsted, Joseph, Co., 388 W. Randolph St.

Heath-Johnson Co., 127 E. Ontario St.
Holmes, Pyott & Co., 13 N. Jefferson St.
Jackson, George W., Inc., 169-179 W. Jackson Blvd.

Kenwood Bridge Co., First Nat'l Bank Bldg.
Muth, Chr., 428 Blue Island Av.

Petersen, H. A., Mfg. Co., 407 Cham. of Com.
South Halsted St. Iron Works, 135 Adams St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.

Standard Company, The, 810 Ry. Exchange.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.

ARCHITECTURAL SCULPTORS.

Architectural Decorating Co., 643 S. Jefferson St.

Builders & Decorators Mfg. Co., 554 N. Halsted St.

Decorators' Supply Co., The, Archer Av. & Leo St.

Dux, Joseph, 132 W. Jackson Blvd.
Hartmann, John, 13 N. Jefferson St.

ARCHITECTURAL TERRA COTTA.

American Terra Cotta & Ceramic Co., The, 602 Chamber of Commerce Bldg.

Northwestern Terra Cotta Co., The, 1415 Railway Exchange Bldg.

ARMORED CONCRETE CONSTRUCTION.

International Fence & Fireproofing Co., The, Columbus, Ohio.

ARTISTS' MATERIAL.

Keuffel & Esser Co., 111 Madison St.

ASBESTOS FIREPROOF LUMBER.

Johns-Manville Co., H. W., 173 Randolph St.

ASBESTOS MANUFACTURERS.

Chicago Fire Proof Covering Co., 173 Randolph St.

Johns-Manville Co., H. W., 173 Randolph St.
Sall Mountain Asbestos Mfg. Co., 79 S. Canal St.

Western Roofing & Supply Co., 177 Randolph St.

ASBESTOS—PIPE AND BOILER COVERING.

Chicago Fire Proof Covering Co., 173 Randolph St.

Johns-Manville Co., H. W., 173 Randolph St.
Sall Mountain Asbestos Mfg. Co., 79 S. Canal St.

Western Roofing & Supply Co., 177 Randolph St.

ASPHALT FLOORS.

Brown, F. E., & Co., 215 Dearborn St.
de Smet, Geo. W., Chamber of Commerce.

Schillinger Bros. Co., 1181 N. Seeley Av.
Simpson Construction Co., 704 Cham. of Com.

ASPHALT—FLOORS, PAVING, ROOFING.

Blome, Rudolph S. Co., 79 Dearborn St.
Brown, F. E., & Co., 215 Dearborn St.

Schillinger Bros. Co., 1181 N. Seeley Av.
Stowell Mfg. Co., 47 Market St.

AUTOMATIC FIRE SPRINKLERS.

Illinois Malleable Iron Co., 537 Diversey Blvd.

Phoenix Fire Extinguisher Co., First National Bank Bldg.

AWNINGS—BRONZE, WOOD AND IRON.

Dodge, H. B. & Co., 525, 108 La Salle St.

AWNINGS—CANVAS (NEW MODEL).

Walger Bros., 1408 N. Halsted St.

BANK AND OFFICE FIXTURES.

Andrews, A. H. Co., The, 174-176 Wabash Ave.
Baumann F. O. Mfg. Co., Blackhawk St. and Smith Ave.
Booth, John, 14 and 16 N. Canal St.
Chicago Bank & Office Fixture Co., 677-679 W. Van Buren St.

BANK AND OFFICE RAILINGS—METAL.

American Bronze Foundry Co., 73rd and Woodlawn Ave.
American Iron & Wire Wks, 575-581 Carroll Av.
Baldwin Brass Works, 232-234 S. Clinton St.
Booth, John, 14 and 16 N. Canal St.
Brown Bros. Mfg. Co., 22d St. & Campbell Av.
Heath-Johnson Co., 127 E. Ontario St.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Standard Company, The, 810 Railway Exchange Bldg.
Voss, Frederick, 617 to 621 Austin Av.
Weary & Beck, Suite 634 First Nat'l Bk. Bldg.

BANK COUNTERS AND FIXTURES—STEEL AND BRONZE.

Art Metal Construction Co., 135 Adams St., and Jamestown, N. Y.

BEAMS AND COLUMNS—IRON AND STEEL.

Bolters, A. Sons, 84 La Salle St.
Butler Street Foundry & Iron Co., 3422-32 Butler St.
Eastern Metal Works, 780 W. Chicago Av.
Halsted, Joseph, Co., 388 W. Randolph St.
Holmes, Pyott & Co., 13 N. Jefferson St.
Illinois Steel Company, 50 Wabasha Av.
Jackson, George W., Inc., 169-179 W. Jackson Blvd.
Morava Construction Co., 1243 Marquette Bldg.
Muth, Chr., 428 Blue Island Av.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Scully Steel & Iron Co., Halsted & Fulton Sts.
Smith, F. P. Wire & Iron Works, 100 Lake St.
South Halsted St. Iron Works, 135 Adams St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.

BELT AND HAND POWER ELEVATORS.

Altizer & Prince Co., 51 Michigan St.
Contractors Supply & Equipment Co., Old Colony Bldg.
Otis Elevator Company, 9 Jackson Blvd.
Reedy, J. W. Elevator Mfg. Co., 91 Illinois St.

BELTING.

Street, R. R. & Co., 184-186 Washington St.
Western Roofing & Supply Co., 177 Randolph St.

BLACK PLATE.

American Sheet & Tin Plate Co., Pittsburg, Pa.; First Nat'l Bank Bldg., Chicago, Ill.; Union Trust Bldg., Cincinnati, O.; Equitable Bldg., Denver, Colo.; Penobscot Bldg., Detroit, Mich.; Hennen Bldg., New Orleans, La.; Battery Park Bldg., New York City; Pennsylvania Bldg., Philadelphia, Pa.; Ainsworth Block, Portland, Ore.; Union Trust Bldg., San Francisco, Cal.; Chemical Bldg., St. Louis, Mo.
Scully Steel & Iron Co., Halsted and Fulton.

BLOCKS.

Macomber & Whyte Rope Co., 266-268 S. Clinton St.

BLOWER REGULATORS.

Davis, G. M. Regulator Co., 144-146 Milwaukee Av.

BLUE AND BLACK PRINTING.

American Blue Print Paper Co., 102-104 Van Buren St. and Railway Exchange Bldg.

Crofoot, Nielsen & Co., 167 E. Washington St.

Dietzgen, Eugene Co., 181 Monroe St.
Keuffel & Esser Co., 111 Madison St.
United States Blue Print Paper Co., 263 La Salle St.

BOILER AND GENERAL CASTINGS.

Butler Street Foundry & Iron Co., 3422-32 Butler St.

BOILER AND PIPE COVERING.

Chicago Fire Proof Covering Co., 173 Randolph St.
Garden City Sand Co., The, 188 Madison St.
Johns-Manville Co., H. W., 173 Randolph St.
Sall Mountain Asbestos Mfg. Co., 79 S. Canal St.
Western Roofing & Supply Co., 177 Randolph St.

BOILERS.

Arcade Steam Heating Co., 70 La Salle Av.
Contractors Supply & Equipment Co., Old Colony Bldg.
Dawson, A. L. & Co., 27-29-31 W. Washington.
Illinois Malleable Iron Co., 537 Diversey Blvd.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Kehm Bros. Co., 226 E. Kinzie St.
Mueller, L. J., Furnace Co., 40 Dearborn St., and Milwaukee, Wis.
Murphy-Dugger-Clark Co., 19 N. Clark St.
Street, R. R. & Co., 184-186 Washington St.

BOILERS—STEAM AND HOT WATER.

Davis Construction Co., 41 Dearborn St.
Deppmann, A. & Co., 212 Illinois St.
Dilzer, Fred, 48 Dearborn St.
Fairbanks, Morse & Co., Franklin and Monroe.
Illinois Malleable Iron Co., 537 Diversey Blvd.
International Heater Co., 48 Dearborn St.
Kehm Bros. Co., 226 E. Kinzie St.
Kewanee Boiler Company, 167 Lake St.
Kroeschell Bros. Co., 55 Erie St.
Mueller, L. J., Furnace Co., 40 Dearborn St., and Milwaukee, Wis.
Murphy-Dugger-Clark Co., 19 N. Clark St.
Norton, F. J., 8 North State St.
Purves Heating Co., 215 Fifth Av.
Western Valve Co., 179 Lake St.
Wilks, S. Mfg. Co., 35th St. & Shields Av.

BONDS.

Marsh & McLennan, 159 La Salle St.

BOOK STACK.

Library Bureau, 156 Wabash Av.
Meleney, Geo. B. & Co., 1044 First National Bank Bldg.

BOTTLING OUTFITS.

Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Blk., Chicago.

BRASS AND COPPER TUBES.

Scully Steel & Iron Co., Halsted and Fulton Sts.

BRASS AND IRON—ARCHITECTURAL.

American Bronze Foundry Co., 73rd and Woodlawn Ave.
American Iron & Wire Wks, 575-581 Carroll Av.
Baldwin Brass Works, 232-234 S. Clinton St.
Brown Bros. Mfg. Co., 22d St. & Campbell Av.
Chicago Ornamental Iron Works, 37th St. and Stewart Av.
Heath-Johnson Co., 127 E. Ontario St.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Standard Company, The, 810 Railway Exchange Bldg.
Voss, Frederick, 617 to 621 Austin Av.

BRASS GOODS.

Dawson Bros., 197-207 N. Halsted St.
Heath-Johnson Co., 127 E. Ontario St.

BRASS, IRON AND WIRE.

Booth, John, 14 and 16 N. Canal St.
Eastern Metal Works, 780 W. Chicago Av.

Halsted, Joseph, Co., 388 W. Randolph St.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Southwestern Architectural Iron Works, 734
Blue Island Ave.
Standard Company, The, 810 Railway Ex-
change.
Vierling, McDowell & Co., 23rd St. and
Stewart Av.

BREWERS' MACHINERY.

Vilter Mfg. Co., The, Milwaukee, Wis., and
Monadnock Bldg., Chicago.

BREWERY AND MALT HOUSE CON- STRUCTION.

Kaestner, Chas. & Co., 241-261 S. Jefferson St.

BRICK BUILDING RAISERS AND MOVERS.

Friestedt, L. P., Co., 1526-28 Tribune Bldg.
Sheeler, H., Co., 716 Chamber of Commerce.

BRICK—COMMON.

Knickerbocker Ice Co., 171 La Salle St.
Labahn Brick Co., 92 and 94 La Salle St.
Moulding, Thomas Co., Chamber of Commerce.
National Brick Co., 84 La Salle St.
Wisconsin Lime & Cement Co., 607 Cham-
ber of Commerce.

BRICK—ENAMELED.

Bonner & Marshall Co., 1107 Chamber of Com.
Chicago Hydraulic Press Brick Co., 3rd Floor
Chamber of Commerce Bldg.
Jenkins & Reynolds Co., The, 1210 Cham. Com.
Kimbell, S. S., Brick Co., 304 Cham. of Com.

BRICK—FIRE.

Garden City Sand Co., The, 188 Madison St.
Harbison-Walker Refractories Co., Cham-
ber of Commerce.
Jenkins & Reynolds Co., The, 1210 Cham. Com.
Moulding, Thomas Co., Chamber of Commerce.
Wisconsin Lime & Cement Co., 607 Cham-
ber of Commerce.

BRICK—ORNAMENTAL AND PLAIN.

Harbison-Walker Refractories Co., Cham-
ber of Commerce.

BRICK—PAVING.

Bonner & Marshall Co., 1107 Chamber of Com.
Garden City Sand Co., The, 188 Madison St.
Jenkins & Reynolds Co., The, 1210 Chamber
of Commerce.
Moulding, Thomas Co., Chamber of Commerce.

BRICK—PRESSED.

Bonner & Marshall Co., 1107 Chamber of Com.
Chicago Hydraulic Press Brick Co., 3rd Floor
Chamber of Commerce Bldg.
Harbison-Walker Refractories Co., Cham-
ber of Commerce.
Jenkins & Reynolds Co., The, 1210 Cham. Com.
Kimbell, S. S., Brick Co., 304 Cham. of Com.
Moulding, Thomas Co., Chamber of Commerce.
Wisconsin Lime & Cement Co., 607 Cham-
ber of Commerce.

BRICK—QUARTZITE.

Harbison-Walker Refractories Co., Cham-
ber of Commerce.

BRICK—SAND MOLD.

Bonner & Marshall Co., 1107 Chamber of Com.
Chicago Hydraulic Press Brick Co., 3rd Floor
Chamber of Commerce Bldg.
Jenkins & Reynolds Co., The, 1210 Chamber
of Commerce.
Kimbell, S. S., Brick Co., 304 Cham. of Com.

BRIDGES—STEEL.

Westcott & Ronneberg, 1107-S, 188 Madison
St.

BRIDGES AND ROOFS.

Jackson, George W., Inc., 169-179 W. Jack-
son Blvd.
Kenwood Bridge Co., First Nat'l Bank Bldg.
Morava Construction Co., 1243 Marquette
Bldg.

Pittsburgh Construction Co., Diamond Bank
Bldg., Pittsburgh, Pa.
Strobel Steel Construction Co., 1744-1748
Monadnock Bldg.

BRONZE WORK.

American Bronze Foundry Co., 73rd and
Woodlawn Ave.
Brown Bros. Mfg. Co., 22d St. & Campbell
Av.
Chicago Ornamental Iron Works, 37th St. and
Stewart Av.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Standard Company, The, 810 Ry. Exchange.
Weary & Beck, Suite 634 First Nat'l Bldg.

BUILDERS' HARDWARE.

Columbian Hardware Co., The, 45 E. Lake St.
Orr & Lockett Hardware Co., 71-73 Randolph.
Reading Hardware Co., 105 Lake St.

BUILDING LOANS.

Baird & Warner, 90 La Salle St.
Greenebaum Sons, 59 Clark St.

BUILDING MATERIALS.

Builders' Material Co., 606 Cham. of Com.
Garden City Sand Co., The, 188 Madison St.
Knickerbocker Ice Co., 171 La Salle St.
Northwestern Terra Cotta Co., The, 1415 Rail-
way Exchange Bldg.
Wisconsin Lime & Cement Co., 607 Cham-
ber of Commerce.

BUILDING PAPERS.

Johns-Manville Co., H. W., 173 Randolph St.
Paine Lumber Co., Chamber of Commerce.
Stowell Mfg. Co., 47 Market St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

BUILDING RAISERS AND MOVERS.

Friestedt, L. P., Co., 1526-28 Tribune Bldg.
Riendeau, L. J., & Son, 925 Stock Ex. Bldg.
Sheeler, H., Co., 716 Chamber of Commerce.

CABINET WORK.

Chicago Bank & Office Fixture Co., 677-
679 W. Van Buren St.

CABINET WORK—STEEL.

Art Metal Construction Co., 135 Adams St.,
and Jamestown, N. Y.
Krag Imperial Cabinet Co., \$14-\$22 Fulton St.

CABLES.

Macomber & Whyte Rope Co., 266-268 S.
Clinton St.

CANOPIES—IRON AND BRONZE.

American Bronze Foundry Co., 73rd and
Woodlawn Ave.
Standard Company, The, 810 Ry. Exchange.
Weary & Beck, Suite 634 First Nat'l Bldg.

CARD INDEXES AND VERTICLE FILING.

Art Metal Construction Co., 135 Adams St.,
and Jamestown, N. Y.

CARD SYSTEMS.

Library Bureau, 156 Wabash Av.
Shaw-Walker Co., The, 151 Wabash Ave.

CARPENTER CONTRACTORS.

Alling Construction Co., 1507-S Chicago Sav.
Bank Bldg.
Bulley & Andrews, 411, 115 Dearborn St.
Bushnell, Carl, 217 Cham. of Com.
Campbell, Arch. M., R. 23, 132 La Salle St.
Clark, C., Everett Co., 1405, 100 Washington
St.
Eilenberger, H., & Co., 153 La Salle St.
Eriesson, John & Henry, 84 La Salle St.
Ewen, John M., Co., The, The Rookery.
Freeman, Hart & Co., Chamber of Commerce.
Gindele, Chas. W., Co., 3333 La Salle St.
Grace, Wm. Company, 1408 Wabash Av.
Griffiths, John & Son, 1009-1011 Merchants
Loan & Trust Bldg.
Ledgerwood, A. J. C., Rooms 516-517, 184
La Salle St.

Lotz, Philip, 58 Wabash Av.
 Mavor, William, Co., 164 Dearborn St.
 Meiling & Walther, 84 La Salle St.
 Moe Ingwald, 217 Cham. of Com.
 Morrice & Barron, 125 La Salle St.
 Mortimer, Wm. H., 280 La Salle St.
 Mueller, Paul P. F., 109 Randolph St.
 Nelson, F. P. & Son, 715-716 Cham. of Com.
 Nollau & Wolff Mfg. Co., 35-45 Fullerton Ave.
 Scharmer, Jacob, 215 Dearborn St.
 Schlueter, Henry W., 204 Dearborn St.
 Snyder, H. V. & Son, 1007 Security Bldg.
 Snyder, J. W., Suite 1009-11, 160 Washington St.
 Sollitt, Ralph, & Sumner Co., 612 Pullman Bldg.
 Strandberg, E. P. Company, 159 La Salle St.
 Stresenreuter Bros., 614 Chamber of Commerce.
 Swift, Geo. B., Company, 902-4 Security Bldg., 188 Madison St.
 Thompson-Starrett Co., Fisher Bldg.
 Todd, James, & Co., 145 La Salle St.
 Tullgren, Mauritz S., & Co., Room 523, 145 La Salle St.
 Warren Construction Co., The (Wm. H. Warren, Prest.), Monadnock Bldg.
 Wells Bros. Company, 1014 Monadnock Bldg.
 Wolfinger, Clarence L., 226 La Salle St.
 Zadeck, B. M. Co., 811, 135 Adams St.

CARVING.

Dux, Joseph, 132 W. Jackson Blvd.
 Hartmann, John, 13 N. Jefferson St.

CAST IRON FENCE POSTS.

Reder Foundry Co., Canalport Av., Sangamon & Johnson Sts.

CASTINGS—GENERAL.

Reder Foundry Co., Canalport Av., Sangamon & Johnson Sts.

CASTINGS—GREY IRON.

Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Bldg., Chicago.

CASUALTY INSURANCE.

Marsh & McLennan, 159 La Salle St.

CEILINGS—COPPER PLATED.

Eller Mfg. Co., The, Canton, Ohio.
 Illinois Metal Ceiling & Supply Co., 23 Lake St.

CEILINGS—EMBOSSED STEEL.

Eller Mfg. Co., The, Canton, Ohio.
 Illinois Metal Ceiling & Supply Co., 23 Lake St.

CEILINGS—ORNAMENTAL STEEL.

Eller Mfg. Co., The, Canton, Ohio.
 Illinois Metal Ceiling & Supply Co., 23 Lake St.
 Keighley, S., Metal Ceiling Mfg. Co., Pittsburgh, Pa.
 Knisely Bros., 28th Place and 5th Av.
 McFarland, J. C. & Co., 27th St. and 5th Ave.
 Sykes Steel Roofing Co., 112-120 W. 19th Pl.
 Watson, W. D. Co., 302 W. Van Buren St.

CEILINGS—SUSPENDED, GROINED AND ARCHED.

Illinois Terra Cotta Lumber Co., 439 The Rookery.
 National Fire Proofing Co., 806 Hartford Bldg.
 Roebing Construction Co., The, Stock Exchange Bldg.

CEMENT.

Atlas Portland Cement Co., First Nat. Bank Bldg.
 Builders' Material Co., 606 Cham. of Com.
 Chicago Portland Cement Co., Stock Exc. Bldg.
 Garden City Sand Co., The, 188 Madison St.
 Jenkins & Reynolds Co., The, 1210 Cham. Com.
 Knickerbocker Ice Co., 171 La Salle St.
 Meacham & Wright, 308-09 Chamber of Com.
 Peerless Portland Cement Co., Union City, Mich.; Chicago Office, 92 La Salle St.
 Schultz, F., 658 S. Halsted St.

Universal Portland Cement Co., Commercial Nat'l Bank Bldg.

Wisconsin Lime and Cement Co., 607 Chamber of Commerce.

CEMENT—AMERICAN AND IMPORTED.

Garden City Sand Co., The, 188 Madison St.
 Jenkins & Reynolds Co., The, 1210 Chamber of Commerce.

Meacham & Wright, 308-09 Chamber of Com.

CEMENT—HYDRAULIC.

Garden City Sand Co., The, 188 Madison St.
 Jenkins & Reynolds Co., The, 1210 Chamber of Commerce.

Knickerbocker Ice Co., 171 La Salle St.

Moulding, Thomas Co., Chamber of Commerce.

CEMENT—MANUFACTURERS.

Atlas Portland Cement Co., First Nat'l Bank Bldg.

Chicago Portland Cement Co., Stock Exc. Bldg.

Peerless Portland Cement Co., Union City, Mich., Chicago Office, 92 La Salle St.

Universal Portland Cement Co., Commercial Nat'l Bank Bldg.

CEMENT PAVING AND FLOORS.

Blome, Rudolph S. Co., 79 Dearborn St.
 Brown, F. E., & Co., 215 Dearborn St.
 Brown Hoisting Machinery Co., The, Cleveland, O.
 Brown & Read, 1212 Hartford Bldg.
 de Smet, Geo. W., Chamber of Commerce.
 Hoeffer & Co., Chamber of Commerce Bldg.
 International Fence & Fireproofing Co., The, Columbus, Ohio.
 Schillinger Bros. Co., 1181 N. Seeley Av.

CEMENT—PORTLAND.

Atlas Portland Cement Co., First Nat'l Bank Bldg.

Chicago Portland Cement Co., Stock Exc. Bldg.

Garden City Sand Co., The, 188 Madison St.

Jenkins & Reynolds Co., The, 1210 Cham. Com.

Knickerbocker Ice Co., 171 La Salle St.

Meacham & Wright, 308-09 Chamber of Com.

Moulding, Thomas Co., Chamber of Commerce.

Peerless Portland Cement Co., Union City, Mich., Chicago Office, 92 La Salle St.

Universal Portland Cement Co., Commercial Nat'l Bank Bldg.

Wisconsin Lime and Cement Co., 607 Chamber of Commerce.

CEMENT SIDEWALKS, PAVING AND FLOORS.

Blome, Rudolph S. Co., 79 Dearborn St.
 Brown, F. E., & Co., 215 Dearborn St.
 Brown Hoisting Machinery Co., The, Cleveland, O.
 Brown & Read, 1212 Hartford Bldg.
 de Smet, Geo. W., Chamber of Commerce.
 Hoeffer & Co., Chamber of Commerce Bldg.
 International Fence & Fireproofing Co., The, Columbus, Ohio.
 Schillinger Bros. Co., 1181 N. Seeley Av.
 Schuller, L., 33 Tilden Ave.
 Simpson Construction Co., 704 Cham. of Com.

CEMENT—UTICA HYDRAULIC.

Garden City Sand Co., The, 188 Madison St.
 Jenkins & Reynolds Co., The, 1210 Chamber of Commerce.

Meacham & Wright, 308-09 Chamber of Com.

CEMENT—WATERPROOFING.

Winslow, E. J., Co., 138 Jackson Blvd.

CEMENT AND CONCRETE CONSTRUCTION.

Blome, Rudolph S. Co., 79 Dearborn St.
 Brown, F. E., & Co., 215 Dearborn St.
 Brown Hoisting Machinery Co., The, Cleveland, O.
 Brown & Read, 1212 Hartford Bldg.
 de Smet, Geo. W., Chamber of Commerce.
 Hoeffer & Co., Chamber of Commerce Bldg.
 International Fence & Fireproofing Co., The, Columbus, Ohio.
 Schillinger Bros. Co., 1181 N. Seeley Av.
 Schuller, L., 33 Tilden Ave.
 Simpson Construction Co., 704 Cham. of Com.

CHEMISTS.

Hunt, Robert W. & Co., 1121 The Rookery.

CHIMNEYS-FOR FACTORIES.

Heine Chimney Co., The, 79 Dearborn St.

CHIMNEYS-FOR PUMPING STATIONS.

ELECTRIC PLANTS, SCHOOLS, ASYLUMS, ETC.

Heine Chimney Co., The, 79 Dearborn St.

CHIMNEY TOPS.

Northwestern Terra Cotta Co., The, 1415 Railway Exchange Bldg.

CLOCKS-TOWER.

Johnson Service Co., 93 Lake St.

CLOTHES DRYERS.

Canton Clothes Dryer & Mfg. Co., Canton, O.
Chicago Dryer Co., 381 Wabash Ave.

Troy Laundry Machinery Co., 23rd and La Salle Sts.

COAL BINS-SUSPENSION TYPE

Brown Hoisting Machinery Co., The, Cleveland, O.

COAL CHUTES.

Ritter, E. W., & Co., 601 Monadnock Blk.

COAL WINDOWS.

Ritter, E. W., & Co., 601 Monadnock Blk.

COAL DOCK TOWERS.

Jeffrey Mfg. Co., Monadnock Bldg., and Columbus, Ohio.

COAL HANDLING MACHINERY FOR POWER PLANTS.

Brown Hoisting Machinery Co., The, Cleveland, Ohio.

Jeffrey Mfg. Co., Monadnock Blk. and Columbus Brothers, 705 Bloomingdale Av.

Weller Mfg. Co., 118 East North Ave.

COMPOSITION FOR EXTERIOR AND INTERIOR-ORNAMENTAL.

Architectural Decorating Co., 643 S. Jefferson.
Builders & Decorators Mfg. Co., 554 N. Halsted St.

Decorators' Supply Co., The, Archer Av. & Leo St.

Hartmann, John, 13 N. Jefferson St.

CONCRETE CONSTRUCTION.

American Concrete Steel Co., Penobscot Bldg., Detroit, Mich.

Brown, F. E., & Co., 215 Dearborn St.

Brown Hoisting Machinery Co., The, Cleveland, O.

Condon & Sinks Co., 1441 Monadnock Blk.

de Smet, Geo. W., Chamber of Commerce.

Expanded Metal & Corrugated Bar Co., St. Louis, Mo.

Hoeffer & Co., Chamber of Commerce Bldg.

International Fence & Fireproofing Co., The, Columbus, Ohio.

Mortimer, Wm. H., 280 La Salle St.

McNulty Bros., 1455 Railway Exchange Bldg.

Pittsburgh Construction Co., Diamond Bank Bldg., Pittsburgh, Pa.

Raymond Concrete Pile Co., 135 Adams St.

Roebbing Construction Co., The, Stock Exchange Bldg.

Schillinger Bros. Co., 1181 N. Seeley Av.

Schuller, L., 33 Tilden Ave.

Simpson Construction Co., 704 Cham. of Com.

Trussed Concrete Steel Co., The, Bedford Bldg., 215 Dearborn St.

CONCRETE FIRE PROOFING.

American Concrete Steel Co., Penobscot Bldg., Detroit, Mich.

Brown & Read, 1212 Hartford Bldg.

Brown, F. E., & Co., 215 Dearborn St.

Condon & Sinks Co., 1441 Monadnock Blk.

de Smet, Geo. W., Chamber of Commerce.

Expanded Metal & Corrugated Bar Co., St. Louis, Mo.

Hoeffer & Co., Chamber of Commerce Bldg.
International Fence & Fireproofing Co., The, Columbus, Ohio.

Roebbing Construction Co., The, Stock Exchange Bldg.

Schillinger Bros. Co., 1181 N. Seeley Av.

Trussed Concrete Steel Co., The, Bedford Bldg., 215 Dearborn St.

CONCRETE MIXERS.

Chicago Concrete Machinery Co., 20 S. Canal St.

Contractors' Supply & Equipment Co., Old Colony Bldg.

International Fence & Fireproofing Co., The, Columbus, Ohio.

CONCRETE PILES.

Raymond Concrete Pile Co., 135 Adams St.

CONCRETE-REINFORCED.

American Concrete Steel Co., Penobscot Bldg., Detroit, Mich.

Condon & Sinks Co., 1441 Monadnock Blk.
Expanded Metal & Corrugated Bar Co., St. Louis, Mo.

Hoeffer & Co., Cham. of Com. Bldg.

Schillinger Bros. Co., 1181 N. Seeley Av.

Trussed Concrete Steel Co., The, Bedford Bldg., 215 Dearborn St.

Westcott & Ronneberg, 1107-8, 188 Madison St.

CONDUCTOR PIPE.

Eller Mfg. Co., The, Canton, Ohio.

CONSOLES AND MANTELS.

Dawson Bros., 197-207 N. Halsted St.

CONTRACTORS AND BUILDERS.

Aling Construction Co., 1507-8 Chicago Sav. Bank Bldg.

Bulley & Andrews, 411, 115 Dearborn St.

Bushnell, Carl, 217 Cham. of Com.

Campbell, Arch. M., R. 23, 132 La Salle St.

Clark C. Everett Co., 1405, 100 Washington St.

Ellenberger, H. & Co., 153 La Salle St.

Eriesson, John & Henry, 84 La Salle St.

Ewen, John M., Co., The, The Rookery.

Falkenau Construction Co., 110 La Salle St.

Freeman, Hart & Co., Chamber of Commerce.

Gindele, Chas. W., Co., 3333 La Salle St.

Grace, Wm. Company, 1408 Wabash Av.

Griffiths, John & Son, 1009-1011 Merchants

Loan & Trust Bldg.

Johnson, F. O., 84 La Salle St.

Laquist & Hilsley Co., 393 North Clark St.

Ledgerwood, A. J. C., Rooms 516-517, 184

La Salle St.

Lotz, Philip, 58 Wabash Av.

Mavor, William, Co., 164 Dearborn St.

Melling & Walther, 84 La Salle St.

Moe Ingwald, 217 Cham. of Com.

Morava Construction Co., 1243 Marquette

Bldg.

Morrice & Barron, 125 La Salle St.

Mortimer, Wm. H., 280 La Salle St.

Mueller, Carl R., Builders' & Traders' Ex-

change, Box 39.

Mueller, Paul P. F., 109 Randolph St.

Nelson, F. P. & Son, 715-716 Cham. of Com.

Rodatz, Jacob, The Rookery.

Scharmer, Jacob, 215 Dearborn St.

Schluter, Henry W., 204 Dearborn St.

Snyder, H. V., & Son, 1007 Security Bldg.

Snyder, J. W., Suite 1009-11, 160 Washing-

ton St.

Sollitt, Ralph, & Sumner Co., 612 Pullman

Bldg.

Strandberg, E. P. Company, 159 La Salle St.

Stresenreuter Bros., 614 Chamber of Commerce.

Swift, Geo. B., Company, 902-4 Security

Bldg., 188 Madison St.

Thompson-Starrett Co., Fisher Bldg.

Todd, James & Co., 145 La Salle St.

Tullgren, Mauritz S., & Co., Room 523, 145

La Salle St.

Warren Construction Co., The (Wm. H.

Warren, Prest.), Monadnock Blk.

Wells Bros. Company, 1014 Monadnock Blk.

Wolfinger, Clarence I., 226 La Salle St.

Zadeck, B. M. Co., 811, 135 Adams St.

CONTRACTORS FOR STREET IMPROVEMENTS, ETC.

Citizens Construction Co., 805-6 Chamber of Commerce Bldg.

CONTRACTORS' SUPPLIES.

Chicago Concrete Machinery Co., 20 S. Canal St.

Contractors Supply & Equipment Co., Old Colony Bldg.

CONVEYORS—SPIRAL STEEL.

Brown Holsting Machinery Co., The, Cleveland, Ohio.

Jeffrey Mfg. Co., Monadnock Bldg., and Columbus, Ohio.

Olson Brothers, 705 Bloomingdale Av.

Webster Mfg. Co., 1075 W. 15th St.

Weller Mfg. Co., 118 East North Ave.

COOLING SYSTEMS FOR BUILDINGS.

Thomas & Smith, 17-19 S. Carpenter St.

COPING.

Northwestern Terra Cotta Co., The, 1415 Railway Exchange Bldg.

CORNER BEADS.

Schuller, L., 33 Tilden Ave.

CORNER BEAD METAL.

Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

CORNICE FINIALS.

Eller Mfg. Co., The, Canton, Ohio.

CORNICE MAKERS' ORNAMENTS.

Illinois Roofing & Cornice Co., 319 W. Kinzie St.

Knisely Co., Harry C., 273 S. Canal St.

CORNICE WORK.

Illinois Roofing & Cornice Co., 319 W. Kinzie St.

Knisely Bros., 28th Place and 5th Av.

Knisely Co., Harry C., 273 S. Canal St.

McFarland, J. C. & Co., 27th St. and 5th Av.

Sykes Steel Roofing Co., 112-120 W. 19th Pl.

Voigtmann, Frank, Cornice Co., 129 N. Franklin St.

Watson, W. D., Co., 302 W. Van Buren St.

CORNICES—COPPER, GALVANIZED.

Canton Art Metal Co., The, Canton, Ohio.

Illinois Roofing & Cornice Co., 319 W. Kinzie St.

Knisely Bros., 28th Place and 5th Av.

Knisely Co., Harry C., 273 S. Canal St.

McFarland, J. C. & Co., 27th St. and 5th Av.

Sykes Steel Roofing Co., 112-120 W. 19th Pl.

Voigtmann, Frank, Cornice Co., 129 N. Franklin St.

Watson, W. D., Co., 302 W. Van Buren St.

CORRUGATED BARS.

Condron & Sinks Co., 1441 Monadnock Bldg.

Expanded Metal & Corrugated Bar Co., St. Louis, Mo.

CORRUGATED IRON.

Knisely Bros., 28th Place and 5th Av.

McFarland, J. C. & Co., 27th St. and 5th Av.

Scully Steel & Iron Co., Halsted and Fulton.

Sykes Steel Roofing Co., 112-120 W. 19th Pl.

Voigtmann, Frank, Cornice Co., 129 N. Franklin St.

Watson, W. D., Co., 302 W. Van Buren St.

COTTON TWINES.

Samson Cordage Works, 115 Congress St., Boston, Mass.

CRUSHED STONE.

Builders' Material Co., 606 Cham. of Com.

CRUSHED STONE DEALERS.

Knickerbocker Ice Co., 171 La Salle St.

Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

CURBING—OOLITIC LIME STONE.

Bedford Quarries Co., The, Room 638, 204 Dearborn St.

CUT STONE CONTRACTORS.

Edwards & Ward, Fullerton Av. Bridge.

Gibson, A. F., & Co., 3327 La Salle St.

CUTLERY AND TOOLS.

Orr & Lockett Hardware Co., 71-73 Randolph.

DAMP COURSES.

Blome, Rudolph S. Co., 79 Dearborn St.

Schillinger Bros. Co., 1181 N. Seeley Av.

Stowell Mfg. Co., 47 Market St.

Watson, H. F. Co., 12-14 S. Clinton St.

DAMP RESISTING COMPOUNDS.

Toch Bros., 320 Fifth Av.

DEADENING FELT—QUILT.

Cabot, Samuel, 28 Dearborn Ave. and Boston, Mass.

DEADENING FELTS.

Cabot, Samuel, 28 Dearborn Ave. and Boston, Mass.

DEADENING MATERIAL.

Johns-Manville Co., H. W. (Keystone), 173 Randolph St.

Watson, H. F. Co., 12-17 S. Clinton St.

DECORATIVE MOULDINGS.

Moore, Geo. F., 186-188-190 24th St.

DECORATORS.

Carpenter, Geo. M., & Co., 1543 Leland Ave.

McCully & Miles Co., 76 Wabash Av.

Spielerling & Linden, 1216 Michigan Av.

DECORATORS—THEATER.

Carpenter, Geo. M., & Co., 1543 Leland Ave.

McCully & Miles Co., 76 Wabash Av.

Spielerling & Linden, 1216 Michigan Av.

DERRICK ROPES.

Macomber & Whyte Rope Co., 266-268 S. Clinton St.

DOORS.

American Compound Door Co., 21st and Morgan St.

Chicago Veneered Door Co., 316 Chamber of Commerce Bldg.

Morgan Sash & Door Co., Blue Island Av. and Wood St.

Noilau & Wolff Mfg. Co., 35-45 Fullerton Av.

Paine Lumber Co., Chamber of Commerce.

DOORS—CROSS HORIZONTAL FOLDING.

Variety Mfg. Co., Sacramento & Carroll Aves.

DOORS—CROSS IMPROVED MEAKER.

Variety Mfg. Co., Sacramento & Carroll Aves.

DOORS—SLIDING SWING.

Dodge, H. B. & Co., 525, 108 La Salle St.

DOORS—VENEERED.

American Compound Door Co., 21st and Morgan St.

Chicago Veneered Door Co., 316 Chamber of Commerce Bldg.

DRAINAGE.

Nilson Bros., 1463 Belmont Av.

Noble & Thumm, 292 Lincoln Av.

DRAWING MATERIALS.

Abbott, A. H. & Co., 151-153 Wabash Av.

American Blue Print Paper Co., 102-104 Van Buren St. and Railway Exchange Bldg.

Dietzgen, Eugene Co., 181 Monroe St.

Keuffel & Esser Co., 111 Madison St.

United States Blue Print Paper Co., 263 La Salle St.

DRUG FIXTURES.

Chicago Bank & Office Fixture Co., 677-679 W. Van Buren St.

DRY ROOMS.

Canton Clothes Dryer & Mfg. Co., Canton, O.
Chicago Dryer Co., 381 Wabash Ave.
Kehm Bros. Co., 226 E. Kinzie St.
Troy Laundry Machinery Co., 23rd and La
Salle Sts.

DYNAMOS.

Chicago Edison Co., 139 Adams St.
Fairbanks, Morse & Co., Franklin and Monroe.
Kohler Bros., 1804-1812 Fisher Bldg.
McFell Electric Co., 257-261 Dearborn St.
Newgard, Henry, & Co., 30-32 W. Van
Buren St.
Western Electric Co., 259 S. Clinton St.

EAVES AND TROUGHS.

Canton Art Metal Co., The, Canton, Ohio.
Eller Mfg. Co., The, Canton, Ohio.

ELECTRIC BELLS AND LIGHTING.

Chicago Edison Co., 139 Adams St.
McFell Electric Co., 257-261 Dearborn St.
Newgard, Henry, & Co., 30-32 W. Van
Buren St.
Western Electric Co., 259 S. Clinton St.

ELECTRIC CONDUITS AND FITTINGS.

Petersen, H. A., Mfg. Co., 407 Cham. of Com.

ELECTRIC ELEVATORS.

Altizer & Prince Co., 51 Michigan St.
Eaton & Prince Co., 70-76 Michigan St.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Otis Elevator Company, 9 Jackson Blvd.
Reedy, J. W. Elevator Mfg. Co., 91 Illinois St.
Western Electric Co., 259 S. Clinton St.

ELECTRIC FIXTURES.

McFell Electric Co., 257-261 Dearborn St.
Tietgen, Falk & Co., 79-81 W. Van Buren St.
Western Electric Co., 259 S. Clinton St.

ELECTRIC MOTORS.

Chicago Edison Co., 139 Adams St.
Fairbanks, Morse & Co., Franklin and Monroe.
Kohler Bros., 1804-1812 Fisher Bldg.
McFell Electric Co., 257-261 Dearborn St.
Newgard, Henry, & Co., 30-32 W. Van
Buren St.
Western Electric Co., 259 S. Clinton St.

ELECTRIC SWITCHES.

Crockett, W. P., 167 S. Canal St.
Fairbanks, Morse & Co., Franklin and Monroe.
Western Electric Co., 259 S. Clinton St.

ELECTRICAL APPARATUS AND SUPPLIES.

Chicago Edison Co., 139 Adams St.
Crockett, W. P., 167 S. Canal St.
Kohler Bros., 1804-1812 Fisher Bldg.
McFell Electric Co., 257-261 Dearborn St.
Newgard, Henry, & Co., 30-32 W. Van
Buren St.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Western Electric Co., 259 S. Clinton St.

ELECTRICAL CONSTRUCTION.

Chicago Edison Co., 139 Adams St.
Crockett, W. P., 167 S. Canal St.
Kohler Bros., 1804-1812 Fisher Bldg.
McFell Electric Co., 257-261 Dearborn St.
Newgard, Henry, & Co., 30-32 W. Van
Buren St.
Western Electric Co., 259 S. Clinton St.

ELECTRICAL FUSES.

Johns-Manville Co., H. W., 173 Randolph St.
Western Electric Co., 259 S. Clinton St.

ELECTRICAL INSULATION.

Petersen, H. A., Mfg. Co., 407 Cham. of Com.

ELEVATING AND CONVEYING MACHINERY.

Brown Hoisting Machinery Co., The, Cleve-
land, Ohio.
Jeffrey Mfg. Co., Monadnock Bldg., and Colum-
bus, Ohio.

Moore & Lorenz Co., 814-822 Fulton St.
Olson Brothers, 705 Bloomingdale Av.
Webster Mfg. Co., 1075 W. 15th St.
Weller Mfg. Co., 118 East North Ave.

ELEVATOR BUCKETS.

Moore & Lorenz Co., 814-822 Fulton St.

ELEVATOR CABLES.

Altizer & Prince Co., 51 Michigan St.

ELEVATOR DOORS AND ENCLOSURES.

American Bronze Foundry Co., 73rd and
Woodlawn Ave.
American Iron & Wire Wks, 575-581 Carroll Av.
Booth, John, 14 and 16 N. Canal St.
Brown Bros. Mfg. Co., 22d St. & Campbell
Av.
Chicago Ornamental Iron Works, 37th St. and
Stewart Av.
Eastern Metal Works, 780 W. Chicago Av.
Eggers, John, Iron Works, 103 S. Canal St.
Halsted, Joseph, Co., 388 W. Randolph St.
Heath-Johnson Co., 127 E. Ontario St.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Southwestern Architectural Iron Works, 734
Blue Island Ave.
Standard Company, The, S10 Railway Ex-
change Bldg.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and
Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.
Winslow Bros. Co., The, W. Harrison St.,
46th & 47th Aves.

ELEVATOR DOORS—FREIGHT.

Harris, S. H. Co., The, 29 Pearce St.

ELEVATOR DOORS—PASSENGER.

Harris, S. H. Co., The, 29 Pearce St.

ELEVATOR ELECTRICAL SIGNALS.

Elevator Supply & Repair Co., 76 W. Monroe.

ELEVATOR FIRE DOORS.

Kinnear Mfg. Co., The, 112 Clark St.
Standard Company, The, S10 Railway Exchange
Bldg.

ELEVATOR FLOOR INDICATORS.

Eaton & Prince Co., 70-76 Michigan St.
Elevator Supply & Repair Co., 76 W. Monroe.
Standard Company, The, S10 Railway Exch.

ELEVATOR MACHINERY.

Altizer & Prince Co., 51 Michigan St.
Eaton & Prince Co., 70-76 Michigan St.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Otis Elevator Company, 9 Jackson Blvd.
Winslow Bros. Co., The, W. Harrison St.,
46th & 47th Aves.

ELEVATOR REPAIRS.

Altizer & Prince Co., 51 Michigan St.
Elevator Supply & Repair Co., 76 W. Monroe.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Otis Elevator Company, 9 Jackson Blvd.
Reedy, J. W. Elevator Mfg. Co., 91 Illinois St.

ELEVATOR ROPES.

Macomber & Whyte Rope Co., 266-268 S.
Clinton St.

ELEVATOR SAFETY GATES.

Altizer & Prince Co., 51 Michigan St.

ELEVATORS—PASSENGER AND FREIGHT.

Altizer & Prince Co., 51 Michigan St.
Eaton & Prince Co., 70-76 Michigan St.
Elevator Supply & Repair Co., 76 W. Monroe.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Otis Elevator Company, 9 Jackson Blvd.
Reedy, J. W. Elevator Mfg. Co., 91 Illinois St.
Winslow Bros. Co., The, W. Harrison St.,
46th & 47th Aves.

ENAMELING STEEL.

American Sheet & Tin Plate Co., Pittsburg, Pa.; First Nat'l Bank Bldg., Chicago, Ill.; Union Trust Bldg., Cincinnati, O.; Equitable Bldg., Denver, Colo.; Penobscot Bldg., Detroit, Mich.; Hennen Bldg., New Orleans, La.; Battery Park Bldg., New York City; Pennsylvania Bldg., Philadelphia, Pa.; Ainsworth Block, Portland, Ore.; Union Trust Bldg., San Francisco, Cal.; Chemical Bldg., St. Louis, Mo.

Oshorn, J. M. & L. A., Co., The, Cleveland, O.

ENGINE BEDS.

Blome, Rudolph S. Co., 79 Dearborn St. de Smet, Geo. W., Chamber of Commerce. Edwards & Ward, Fullerton Av. Bridge. Hoeffer & Co., Chamber of Commerce Bldg. Schilling Bros. Co., 1181 N. Seeley Av. Simpson Construction Co., 704 Cham. of Com.

ENGINEER AND CONTRACTOR FOR CENTRAL STATION HEATING PLANTS.

Schott, W. H., 1100, 1128 Amer. Trust Bldg.

ENGINEERS:

American Engineering Specialty Co., 1510 Monadnock Blk. Consolidated Engineering Co., 42 W. Jackson Blvd. Hunt, Robert W. & Co., 1121 The Rookery. Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Blk., Chicago.

ENGINEERS—CIVIL.

Greeley-Howard Co., 822, 112 Clark St. Westcott & Ronneberg, 1107-8, 188 Madison St.

ENGINEERS—CONSULTING.

Westcott & Ronneberg, 1107-8, 188 Madison St.

ENGINEERS—CONTRACTING.

American Engineering Specialty Co., 1510 Monadnock Blk. Consolidated Engineering Co., 42 W. Jackson Blvd. Kohler Bros., 1804-1812 Fisher Bldg. Morava Construction Co., 1243 Marquette Bldg. Strobel Steel Construction Co., 1744-1748 Monadnock Blk.

ENGINEERS—STRUCTURAL.

American Concrete Steel Co., Penobscot Bldg., Detroit, Mich. Condron & Sinks Co., 1441 Monadnock Blk. Ewen, John M., Co., The, The Rookery. Expanded Metal & Corrugated Bar Co., St. Louis, Mo. Morava Construction Co., 1243 Marquette Bldg.

ENGINES.

Contractors Supply & Equipment Co., Old Colony Bldg. Dawson, A. L. & Co., 27-29-31 W. Washington. Fairbanks, Morse & Co., Franklin and Monroe. Kaestner, Chas. & Co., 241-261 S. Jefferson St. Rider-Ericsson Engine Co., 40 Dearborn St. Street, R. R. & Co., 184-186 Washington St. Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Blk., Chicago.

ENGINES—CORLISS.

Street, R. R. & Co., 184-186 Washington St. Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Blk., Chicago.

ENGINES—GAS.

Fairbanks, Morse & Co., Franklin and Monroe. Webster Mfg. Co., 1075 W. 15th St.

ENGINES—HOISTING.

Contractors Supply & Equipment Co., Old Colony Bldg.

EXHAUST FANS.

Variety Mfg. Co., Sacramento & Carroll Aves.

EXHAUST HEADS.

Burt Mfg. Co., 40 Dearborn St., and Akron, Ohio.

EXPANDED METAL.

Northwestern Expanded Metal Co., Old Colony Bldg.

EXPANDED METAL LATH.

Northwestern Expanded Metal Co., Old Colony Bldg.

EXPANSION TANKS.

International Heater Co., 48 Dearborn St. Kroeschell Bros. Co., 55 Erie St.

FEED WATER HEATERS.

American Engineering Specialty Co., 1510 Monadnock Blk. Dawson, A. L. & Co., 27-29-31 W. Washington.

FENCING AND WINDOW GUARDS.

Northwestern Expanded Metal Co., Old Colony Bldg.

FERRO CEMENT CONSTRUCTION.

Blome, Rudolph S. Co., 79 Dearborn St. Brown, F. E., & Co., 215 Dearborn St. Brown Hoisting Machinery Co., The, Cleveland, O. de Smet, Geo. W., Chamber of Commerce. Hoeffer & Co., Chamber of Commerce Bldg. Simpson Construction Co., 704 Cham. of Com.

FILING DEVICES.

Art Metal Construction Co., 135 Adams St., and Jamestown, N. Y. Krag Imperial Cabinet Co., 814-822 Fulton St. Shaw-Walker Co., The, 151 Wabash Ave.

FILLING AND SODDING.

Krugs, 167 Dearborn St.

FILTERS.

Loomis-Manning Filter Co., 826 Land Title Bldg., Pittsburgh, Pa.

FILTERS—FOR RESIDENCES, HOSPITALS, HOTELS, APARTMENT AND OFFICE BUILDINGS.

Loomis-Manning Filter Co., 826 Land Title Bldg., Pittsburgh, Pa.

FILTERS—OIL.

Burt Mfg. Co., 40 Dearborn St., and Akron, Ohio.

FIRE APPARATUS.

Phoenix Fire Extinguisher Co., First National Bank Bldg.

FIRE BRICK AND CLAY.

Builders' Material Co., 606 Cham. of Com. Garden City Sand Co., The, 188 Madison St. Jenkins & Reynolds Co., The, 1210 Cham. Com. Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

FIRE DOORS.

Harris, S. H. Co., The, 29 Pearce St. Smith, F. P. Wire & Iron Works, 100 Lake St. Variety Mfg. Co., Sacramento & Carroll Aves. Voss, Frederick, 617 to 621 Austin Av.

FIRE DOORS FOR ELEVATORS.

Harris, S. H. Co., The, 29 Pearce St.

FIRE ESCAPES.

Booth, John, 14 and 16 N. Canal St. Central Iron Works of Chicago, 263-265 West Lake St. Eastern Metal Works, 780 W. Chicago Av. Eggers, John, Iron Works, 103 S. Canal St. Halsted, Joseph, Co., 388 W. Randolph St. Muth, Chr., 428 Blue Island Av. Petersen, H. A., Mfg. Co., 407 Cham. of Com. Smith, F. P. Wire & Iron Works, 100 Lake St. Southwestern Architectural Iron Works, 734 Blue Island Av. Union Foundry Works, First Nat'l Bank Bldg. Vierling, McDowell & Co., 23rd St. and Stewart Av. Voss, Frederick, 617 to 621 Austin Av.

FIRE EXTINGUISHERS.

Phoenix Fire Extinguisher Co., First National Bank Bldg.

FIREPLACE FURNISHINGS, ETC.

Dawson Bros., 197-207 N. Halsted St.

FIREPLACES

Dawson Bros., 197-207 N. Halsted St.

FIREPROOF FLOORS.

Brown Hoisting Machinery Co., The, Cleveland, O.
Illinois Terra Cotta Lumber Co., The, The Rookery.
Trussed Concrete Steel Co., The, Bedford Bldg., 215 Dearborn St.

FIREPROOF LATH.

Brown Hoisting Machinery Co., The, Cleveland, O.
Northwestern Expanded Metal Co., 790 Old Colony Bldg.

FIREPROOF LOCKERS.

Churchill & Spalding, 464-478 Carroll Ave.

FIREPROOF PAINTS.

Muralo Co., The, 24 Market St.
Western Roofing & Supply Co., 177 Randolph St.

FIREPROOF PAINTS—ANTI-FLAME.

Chicago Fire Proof Covering Co., 173 Randolph St.

FIREPROOF PARTITIONS.

Brown Hoisting Machinery Co., The, Cleveland, O.
Illinois Terra Cotta Lumber Co., 439 The Rookery.
International Fence & Fireproofing Co., The, Columbus, Ohio.
National Fire Proofing Co., 806 Hartford Bldg.
Roebbing Construction Co., The, Stock Exchange Bldg.
Voss, Frederick, 617 to 621 Austin Av.

FIREPROOF SAFES.

Donnell Safe Co., 200 Washington St.
Harris, S. H. Co., The, 29 Pearce St.

FIREPROOF SASH AND FRAMES.

Illinois Roofing & Cornice Co., 319 W. Kinzie St.
Knisely Bros., 28th Place and 5th Av.
Knisely Co., Harry C., 273 S. Canal St.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.
Volgtman & Company, 42-54 E. Erie St.
Watson, W. D. Co., 302 W. Van Buren St.

FIRE PROOF SHUTTERS AND DOORS.

Dodge, H. B. & Co., 525, 108 La Salle St.
Eggers, John, Iron Works, 103 S. Canal St.
Kinnear Mfg. Co., The, 112 Clark St.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Voss, Frederick, 617 to 621 Austin Av.

FIREPROOF WINDOWS.

Illinois Roofing & Cornice Co., 319 W. Kinzie St.
Knisely Bros., 28th Place and 5th Av.
Knisely Co., Harry C., 273 S. Canal St.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.
Volgtman & Company, 42-54 E. Erie St.
Watson, W. D. Co., 302 W. Van Buren St.

FIRE PROOF WIRE LATH.

General Fireproofing Co., The, 315 Old Colony Bldg., Chicago; 212 Federal Bldg., Youngstown, Ohio.
Northwestern Expanded Metal Co., Old Colony Bldg.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Roebbing Construction Co., The, Stock Exchange Bldg.
Voss, Frederick, 617 to 621 Austin Av.

FIRE PROOFING.

Brown Hoisting Machinery Co., The, Cleveland, O.

General Fireproofing Co., The, 315 Old Colony Bldg., Chicago; 212 Federal Bldg., Youngstown, Ohio.

Illinois Terra Cotta Lumber Co., 439 The Rookery.

International Fence & Fireproofing Co., The, Columbus, Ohio.

National Fireproofing Co., 806 Hartford Bldg.
Roebbing Construction Co., The, Stock Exchange Bldg.

Trussed Concrete Steel Co., The, Bedford Bldg., 215 Dearborn St.

FIREPROOFING—CONCRETE.

American Concrete Steel Co., Penobscot Bldg., Detroit, Mich.
Condron & Sinks Co., 1441 Monadnock Blk.
Expanded Metal & Corrugated Bar Co., St. Louis, Mo.
Schillinger Bros. Co., 1181 N. Seeley Av.

FIRE WINDOWS.

Illinois Roofing & Cornice Co., 319 W. Kinzie St.
Knisely Bros., 28th Place and 5th Av.
Knisely Co., Harry C., 273 S. Canal St.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.
Watson, W. D. Co., 302 W. Van Buren St.

FLOOR AND ROOF LIGHTS.

Brown Bros. Mfg. Co., 22d St. & Campbell Av.
Ritter, E. W., & Co., 601 Monadnock Blk.

FLOOR HINGES.

Columbian Hardware Co., The, 45 E. Lake St.

FLOORING—HARDWOOD.

Chandler Lumber Company, 100 Elston Av.
Hettler, Herman H. Lumber Co., 1324 Elston.
Newcomb, E. R., 14 E. Monroe St.
Rittenhouse & Embree Co., 3500 Center Av.
Wilce, T. Co., The, 22nd and Throop Sts.

FLOORING—OAK AND MAPLE.

Hettler, Herman H. Lumber Co., 1324 Elston.

FLOORING—WOOD BLOCK.

Dodge, H. B. & Co., 525, 108 La Salle St.

FLUE LININGS.

Chicago Hydraulic Press Brick Co., 3rd Floor Chamber of Commerce Bldg.
Garden City Sand Co., The, 188 Madison St.

FORGINGS.

Jackson, George W., Inc., 169-179 W. Jackson Blvd.
Kenwood Bridge Co., First Nat'l Bank Bldg.

FOUNDATIONS—CONCRETE.

Brown & Read, 1212 Hartford Bldg.
Hoeffer & Co., Chamber of Commerce Bldg.
Raymond Concrete Pile Co., 135 Adams St.
Schillinger Bros. Co., 1181 N. Seeley Av.
Westcott & Ronneberg, 1107-8, 188 Madison St.

FOUNDERS.

Illinois Malleable Iron Co., 537 Diversey Blvd.
Jeffrey Mfg. Co., Monadnock Bldg., and Columbus, Ohio.
Webster Mfg. Co., 1075 W. 15th St.

FRAMES—WINDOW.

Morgan Sash & Door Co., Blue Island Av. and Wood St.

FRAMES—WINDOW & DOOR.

Brunton, Julius, 4013-17 Wentworth Av.
Nollau & Wolf Mfg. Co., 35-45 Fullerton Ave.
Palne Lumber Co., Chamber of Commerce.

FREIGHT CARRIERS—UNDER GROUND.

Illinois Tunnel Co., 179 Monroe St.

FRICTION CLUTCHES.

Brown Hoisting Machinery Co., The, Cleveland, Ohio.
Jeffrey Mfg. Co., Monadnock Bldg., and Columbus, Ohio.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.

Olson Brothers, 705 Bloomingdale Av.
Webster Mfg. Co., 1075 W. 15th St.
Weller Mfg. Co., 118 East North Av.

FURNACES.

International Heater Co., 48 Dearborn St.
Lewis & Kitchen, 1200 Michigan Av.
Mueller, L. J., Furnace Co., 40 Dearborn St.,
and Milwaukee, Wis.

FURNITURE-STEEL.

Art Metal Construction Co., 135 Adams St.,
and Jamestown, N. Y.
Canton Art Metal Co., The, Canton, Ohio.
General Fireproofing Co., The, 315 Old Colony
Bldg., Chicago; 212 Federal Bldg., Youngs-
town, Ohio.
Krag Imperial Cabinet Co., 314-322 Fulton St.
Library Bureau, 156 Wabash Av.

GALVANIZED AND BLACK SHEETS.

Eller Mfg. Co., The, Canton, Ohio.
Scully Steel & Iron Co., Halsted & Fulton.

GALVANIZED IRON.

Knelsely Bros., 28th Place and 5th Av.
Scully Steel & Iron Co., Halsted & Fulton.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.
Watson, W. D. Co., 392 W. Van Buren St.

GAS BROILERS.

Detroit Stove Works, 2921 to 2933 S. La Salle
St., Chicago, Ill.

GAS FITTING.

Nilson Bros., 1463 Belmont Av.
Noble & Thumm, 292 Lincoln Av.

GAS FIXTURES.

Tietgen, Falk & Co., 79-81 W. Van Buren St.

GAS-ILLUMINATING.

People's Gas Light & Coke Co., Michigan Av.
and Adams St.

GAS LOGS AND GAS GRATES FOR FIRE- PLACES.

Dawson Bros., 197-207 N. Halsted St.

GAS MACHINES.

Johnson Service Co., 93 Lake St.

GAS-NATURAL.

People's Gas Light & Coke Co., Michigan Av.
and Adams St.

GAS RANGES.

Detroit Stove Works, 2921 to 2933 S. La Salle
St., Chicago, Ill.

GAS WATER HEATERS.

Detroit Stove Works, 2921 to 2933 S. La Salle
St., Chicago, Ill.

GAUGES-STEAM.

Consolidated Engineering Co., 42 W. Jack-
son Blvd.

Murphy-Dugger-Clark Co., 19 N. Clark St.

GENERAL CONTRACTORS.

Alling Construction Co., 1507-S Chicago Sav.
Bank Bldg.

Bulley & Andrews, 411, 115 Dearborn St.
Bushnell, Carl, 217 Cham. of Com.
Campbell, Arch. M., R. 23, 132 La Salle St.
Clark C. Everett Co., 1405, 100 Washington St.
Ellenberger, H., & Co., 153 La Salle St.
Ericsson, John & Henry, 84 La Salle St.
Ewen, John M., Co., The, The Rookery.
Falkenau Construction Co., 110 La Salle St.
Freeman, Hart & Co., Chamber of Commerce.
Gindele, Chas. W., Co., 3333 La Salle St.
Grace, Wm. Company, 1408 Wabash Av.
Griffiths, John & Son, 1009-1011 Merchants
Loan & Trust Bldg.
Johnson, F. O., 84 La Salle St.
-angquist & Illsley Co., 393 North Clark St.
Ledgerwood, A. J. C., Rooms 516-517, 184
La Salle St.

Lotz, Philip, 58 Wabash Av.
Mavor, William Co., 164 Dearborn St.
Melling & Walther, 84 La Salle St.

Moe Ingwald, 217 Cham. of Com.
Morava Construction Co., 1243 Marquette.
Morrice & Barron, 125 La Salle St.
Mortimer, Wm. H., 280 La Salle St.
Mueller, Carl R., Builders' & Traders' Ex-
change, Box 39.
Mueller, Paul P. F., 109 Randolph St.
Nelson, F. P. & Son, 715-716 Cham. of Com.
Pittsburgh Construction Co., Diamond Bank
Bldg., Pittsburgh, Pa.
Rodatz, Jacob, The Rookery.
Scharmer, Jacob, 215 Dearborn St.
Schlueter, Henry W., 204 Dearborn St.
Schuller, L., 33 Tilden Ave.
Snyder, H. V., & Son, 1007 Security Bldg.
Snyder, J. W., Suite 1009-11, 160 Washing-
ton St.
Solliet, Ralph, & Sumner Co., 612 Pullman
Bldg.
Strandberg, E. P. Company, 159 La Salle St.
Stresenreuter Bros., 614 Chamber of Commerce.
Swift, Geo. B., Company, 902-4 Security
Bldg., 188 Madison St.
Thompson-Starrett Co., Fisher Bldg.
Todd, James, & Co., 145 La Salle St.
Tullgren, Mauritz S., & Co., Room 523, 145
La Salle St.
Volkman, Chas. & Co., 184 Dearborn St.
Warren Construction Co., The (Wm. H.
Warren, Prest.), Monadnock Bldg.
Wells Bros. Company, 1014 Monadnock Bldg.
Wolfinger, Clarence L., 226 La Salle St.
Zadeck, B. M. Co., 311, 135 Adams St.

GLASS.

American Luxfer Prism Co., Heyworth Bldg.

GLASS-ART, ORNAMENTAL AND STAINED.

American Luxfer Prism Co., Heyworth Bldg.
Carpenter, Geo. M., & Co., 1543 Leland Ave.
Linden Glass Co., 1216 Michigan Av.
McCully & Miles Co., 76 Wabash Av.
Schuler & Mueller, Madison and Canal Sts.
Spierling & Linden, 1216 Michigan Av.

GLASS-CUT.

Schuler & Mueller, Madison and Canal Sts.

GLASS-BEVELED.

American Luxfer Prism Co., Heyworth Bldg.
Schuler & Mueller, Madison and Canal Sts.

GLASS-MOSAIC.

Linden Glass Co., 1216 Michigan Av.
Schuler & Mueller, Madison and Canal Sts.

GLASS-PRISMATIC.

American Luxfer Prism Co., Heyworth Bldg.

GLASS-WIRE.

Mississippi Wire & Glass Co., 72 Madison St.

GRAIN ELEVATOR MACHINERY.

Brown Hoisting Machinery Co., The, Cleve-
land, Ohio.
Jeffrey Mfg. Co., Monadnock Bldg., and Colum-
bus, Ohio.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Olson Brothers, 705 Bloomingdale Av.
Webster Mfg. Co., 1075 W. 15th St.
Weller Mfg. Co., 118 East North Av.

GRANITE.

Edwards & Ward, Fullerton Av. Bridge.

GRANITE QUARRIES.

American Granite Co., 313 Chamber of Com-
merce Bldg.

GRANITE-BUILDING.

American Granite Co., 313 Chamber of Com-
merce Bldg.

GRANITE-CRUSHED.

American Granite Co., 313 Chamber of Com-
merce Bldg.

GRANITE PAVING BLOCKS.

American Granite Co., 313 Chamber of Com-
merce Bldg.

GRATES FOR FIREPLACES.

Dawson Bros., 197-207 N. Halsted St.

GRAVEL.

American Sand & Gravel Co., 907 Cham. of
Com. Bldg.

Knickerbocker Ice Co., 171 La Salle St.

GRILLE WORK.

Architectural Decorating Co., 643 S. Jefferson.
Builders & Decorators Mfg. Co., 554 N. Hal-
sted St.

Chicago Oriental Iron Works, 37th St. and
Stewart Av.

Hartmann, John, 13 N. Jefferson St.

GRILLE WORK—METAL.

American Bronze Foundry Co., 73rd and
Woodlawn Ave.

Brown Bros. Mfg. Co., 22d St. & Campbell
Av.

Heath-Johnson Co., 127 E. Ontario St.

Smith, F. P. Wire & Iron Works, 100 Lake St.
Standard Company, The, 810 Railway Exch

Weary & Beck, Suite 634 First Nat'l Bk. Bldg.

GRILLES.

Decorators' Supply Co., The, Archer Av. &
Leo St.

GUTTERS AND CONDUCTORS.

Canton Art Metal Co., The, Canton, Ohio.

HAIR FELT.

Chicago Fire Proof Covering Co., 173 Ran-
dolph St.

Johns-Manville Co., H. W., 173 Randolph St.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.

Western Roofing & Supply Co., 177 Ran-
dolph St.

HANGERS AND SHAFTING.

Street, R. R. & Co., 184-186 Washington St.

HANGERS—JOIST.

Columbian Hardware Co., The, 45 E. Lake St.

HARDWARE.

Columbian Hardware Co., The, 45 E. Lake St.
Orr & Lockett Hardware Co., 71-73 Randolph.

HARDWARE—BUILDERS'.

Orr & Lockett Hardware Co., 71-73 Randolph.

HARDWARE—MANUFACTURERS'.

Columbian Hardware Co., The, 45 E. Lake St.
Reading Hardware Co., 105 Lake St.

HARDWARE SPECIALTIES.

Columbian Hardware Co., The, 45 E. Lake St.
Reading Hardware Co., 105 Lake St.
Ritter, E. W., & Co., 601 Monadnock Bldg.

HARDWOOD FLOORING.

Chandler Lumber Company, 100 Elston Av.
Fettler, Herman H. Lumber Co., 1324 Elston.
Newcomb, E. R., 14 E. Monroe St.
Hittenhouse & Embree Co., 3500 Center Av.
Vilce, T. Co., The, 22nd and Throop Sts.

HARDWOOD FLOORING—MANU- FACTURERS.

Vilce, T. Co., The, 22nd and Throop Sts.

HARDWOOD FLOORS.

Dunfee, J., & Co., 104-106 Franklin St.
Newcomb, E. R., 14 E. Monroe.

HARDWOOD LUMBER.

Chandler Lumber Company, 100 Elston Av.
Fettler, Herman H., Lumber Co., 1324 Els-
ton Ave.
Hittenhouse & Embree Co., 3500 Center Av.
Vilce, T. Co., The, 22nd and Throop Sts.

HEAT REGULATION.

Johnson Service Co., 93 Lake St.
Powers Regulator Co., The, 40 Dearborn St.

HEATERS.

Street, R. R. & Co., 184-186 Washington St.

HEATERS—COMBINATION.

International Heater Co., 48 Dearborn St.

HEATING APPARATUS.

American Engineering Specialty Co., 1510
Monadnock Bldg.

Consolidated Engineering Co., 42 W. Jack-
son Blvd.

Crane, M. H. Estate, 609 Security Bldg.

Davis Construction Co., 41 Dearborn St.

Deppmann, A. & Co., 212 Illinois St.

Dilzer Fred, 48 Dearborn St.

Graves, W. B. Co., 121 Kinzie St.

Illinois Malleable Iron Co., 537 Diversey
Blvd.

International Heater Co., 48 Dearborn St.

Kewanee Boiler Company, 167 Lake St.

Kroeschell Bros. Co., 55 Erie St.

Lewis & Kitchen, 1200 Michigan Av.

Mueller, L. J., Furnace Co., 40 Dearborn St.,
and Milwaukee, Wis.

Murphy-Dugger-Clark Co., 19 N. Clark St.

Nilson Bros., 1463 Belmont Av.

Norton, F. J., 8 North State St.

Phillips-Getschow Co., 184 Indiana St.

Pope, William A., 80 Lake St.

Purves Heating Co., 215 Fifth Av.

Thomas & Smith, 17-19 S. Carpenter St.

Wilks, S. Mfg. Co., 35th St. & Shields Av.

HEATING SUPPLIES.

Crane, M. H. Estate, 609 Security Bldg.

Davis, G. M. Regulator Co., 144-146 Milwau-
kee Av.

Davis Construction Co., 41 Dearborn St.

Illinois Malleable Iron Co., 537 Diversey
Blvd.

International Heater Co., 48 Dearborn St.

Kehm Bros. Co., 226 E. Kinzie St.

Kewanee Boiler Company, 167 Lake St.

Kroeschell Bros. Co., 55 Erie St.

Mueller, L. J., Furnace Co., 40 Dearborn St.,
and Milwaukee, Wis.

Murphy-Dugger-Clark Co., 19 N. Clark St.

Phillips-Getschow Co., 184 Indiana St.

Western Kieley Specialty Co., 112 E. Lake St.

Wilks, S. Mfg. Co., 35th St. & Shields Av.

HEATING AND VENTILATING.

American Engineering Specialty Co., 1510
Monadnock Bldg.

Arcade Steam Heating Co., 70 La Salle Av.

Consolidated Engineering Co., 42 W. Jack-
son Blvd.

Crane, M. H. Estate, 609 Security Bldg.

Davis Construction Co., 41 Dearborn St.

Dilzer, Fred, 48 Dearborn St.

Graves, W. B. Co., 121 Kinzie St.

Ideal Heating Co., 6312 Wentworth Av.

Kirk, Geo. H., 6612 Wentworth Av.

Kroeschell Bros. Co., 55 Erie St.

Lewis & Kitchen, 1200 Michigan Av.

Mueller, L. J., Furnace Co., 40 Dearborn St.,
and Milwaukee, Wis.

Nilson Bros., 1463 Belmont Av.

Norton, F. J., 8 North State St.

Phillips-Getschow Co., 184 Indiana St.

Pope, William A., 80 Lake St.

Prentice, L. H. Company, 24-26 Sherman St.

Purves Heating Co., 215 Fifth Av.

Thomas & Smith, 17-19 S. Carpenter St.

HEATING AND VENTILATING—ENGI- NEERS.

Crane, M. H., Estate, 609 Security Bldg.

HEAVY FOUNDATIONS.

Jackson, George W., Inc., 169-179 W. Jack-
son Blvd.

HECTOGRAPH PRINTS.

American Blue Print Paper Co., 102-104 Van
Buren St. and Railway Exchange Bldg.

Crofoot, Nielsen & Co., 167 E. Washington
St.

United States Blue Print Paper Co., 263 La
Salle St.

HOISTING AND CONVEYING MACHIN- ERY.

Brown Hoisting Machinery Co., The, Clevel-
land, O.

Jeffrey Mfg. Co., Monadnock Bldg. and Columbus, Ohio.
Olson Brothers, 705 Bloomingdale Av.
Webster Mfg. Co., 1075 W. 15th St.
Weller Mfg. Co., 115 East North Av.

HOISTING ROPES.

Macomber & Whyte Rope Co., 266-268 S. Clinton St.

HORIZONTAL FOLDING DOORS.

Harris, S. H. Co., The, 29 Pearce St.

HOT BLAST HEATING APPARATUS.

American Engineering Specialty Co., 1510 Monadnock Bldg.
Arcade Steam Heating Co., 70 La Salle Av.
Davis, G. M. Regulator Co., 144-146 Milwaukee Av.
Deppmann, A. & Co., 212 Illinois St.
Kehm Bros. Co., 226 E. Kinzie St.
Phillips-Getschow Co., 184 Indiana St.
Prentice, L. H. Company, 24-26 Sherman St.

HOT WATER HEATERS.

American Engineering Specialty Co., 1510 Monadnock Bldg.
Arcade Steam Heating Co., 70 La Salle Av.
Davis Construction Co., 41 Dearborn St.
Dilzer, Fred, 48 Dearborn St.
Illinois Malleable Iron Co., 537 Diversey Blvd.
International Heater Co., 48 Dearborn St.
Kewanee Boiler Company, 107 Lake St.
Kroeschell Bros. Co., 55 Erie St.
Lewis & Kitchen, 1200 Michigan Av.
Mueller, L. J., Furnace Co., 40 Dearborn St., and Milwaukee, Wis.
Murphy-Dugger-Clark Co., 19 N. Clark St.
Phillips-Getschow Co., 184 Indiana St.
Purves Heating Co., 215 Fifth Av.
Thomas & Smith, 17-19 S. Carpenter St.
Wilks, S. Mfg. Co., 35th St. & Shields Av.

HOT WATER AND STEAM HEATING.

Arcade Steam Heating Co., 70 La Salle Av.
Crane, M. H. Estate, 609 Security Bldg.
Deppmann, A. & Co., 212 Illinois St.
Dilzer, Fred, 48 Dearborn St.
Graves, W. B., Co., 121 Kinzie St.
Ideal Heating Co., 6312 Wentworth Av.
Kehm Bros. Co., 226 E. Kinzie St.
Kirk, Geo. H., 6812 Wentworth Av.
Kroeschell Bros. Co., 55 Erie St.
Lewis & Kitchen, 1200 Michigan Av.
Mueller, L. J., Furnace Co., 40 Dearborn St., and Milwaukee, Wis.
Murphy-Dugger-Clark Co., 19 N. Clark St.
Nacey, P. Co., 315-317 Wabash Av.
Nilson Bros., 1463 Belmont Av.
Noble & Thumm, 292 Lincoln Av.
Norton, F. J., 8 North State St.
Phillips-Getschow Co., 184 Indiana St.
Pope, William A., 80 Lake St.
Prentice, L. H. Company, 24-26 Sherman St.
Purves Heating Co., 215 Fifth Av.
Thomas & Smith, 17-19 S. Carpenter St.

HOUSE MOVERS AND RAISERS.

Friestedt, L. P., Co., 1526-28 Tribune Bldg.
Riendeau, L. J. & Son, 928 Stock Ex. Bldg.
Sheeler, H., Co., 716 Chamber of Commerce.

HYDRAULIC ELEVATORS.

Alitzer & Prince Co., 51 Michigan St.
Eaton & Prince Co., 70-76 Michigan St.
Otis Elevator Company, 9 Jackson Blvd.
Reedy, J. W. Elevator Mfg. Co., 91 Illinois St.

HYDROLITHIC COATING AND CONSTRUCTION.

Winslow, E. J., Co., 138 Jackson Blvd.

HYGIENIC KALSOMINE.

Rubber Paint Company, 150-156 W. Van Buren.

ICE FACTORY AND REFRIGERATING PLANT SUPPLIES.

Creamery Package Mfg. Co., The, 184 Kinzie St.

Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Bldg., Chicago.
Wolf, Fred W. Co., The, 139 Rees St.
York Mfg. Co., 1060 Monadnock Block.

ICE MAKING MACHINERY.

Creamery Package Mfg. Co., The, 184 Kinzie St.
Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Bldg., Chicago.
Wolf, Fred W. Co., The, 139 Rees St.

ICE MAKING AND REFRIGERATING MACHINERY.

Creamery Package Mfg. Co., The, 184 Kinzie St.
Vilter Mfg. Co., The, Milwaukee, Wis., and Monadnock Bldg., Chicago.
Wolf, Fred W. Co., The, 139 Rees St.
York Mfg. Co., 1060 Monadnock Block.

INDUCED DRAFT REGULATORS.

Davis, G. M. Regulator Co., 144-146 Milwaukee Av.

INSPECTORS.

Hunt, Robert W. & Co., 1121 The Rookery.

INSULATING PAPERS.

Johns-Manville Co., H. W., 173 Randolph St.
Western Roofing & Supply Co., 177 Randolph St.

INSULATION-BREWERIES AND COLD STORAGE WAREHOUSES.

Illinois Terra Cotta Lumber Co., 439 The Rookery.
National Fire Proofing Co., 806 Hartford Bldg.

INSURANCE.

Marsh & McLennan, 159 La Salle St.

INSURANCE (IN ALL ITS BRANCHES).

Marsh & McLennan, 159 La Salle St.

INTERIOR DECORATORS.

Architectural Decorating Co., 643 S. Jefferson.
Builders & Decorators Mfg. Co., 554 N. Halsted St.
Carpenter, Geo. M., & Co., 1543 Leland Ave.
McCully & Miles Co., 76 Wabash Av.
Spierling & Linden, 1216 Michigan Av.

INTERIOR FINISH.

American Compound Door Co., 21st and Morgan St.
Baumann F. O. Mfg. Co., Blackhawk St. and Smith Ave.
Chicago Veneered Door Co., 316 Chamber of Commerce Bldg.
Mears, Slayton Lumber Co., 1103 Belmont Ave.
Nollau & Wolff Mfg. Co., 35-45 Fullerton Ave.
Wolffinger, Clarence I., 226 La Salle St.

INTERIOR MOLDINGS.

Moore, George F., 186-188-190 24th St.
Nollau & Wolff Mfg. Co., 35-45 Fullerton Ave.

INTERIOR VAULT CONSTRUCTION.

Art Metal Construction Co., 135 Adams St., and Jamestown, N. Y.
Krag Imperial Cabinet Co., 814-822 Fulton St.

INTERLOCKING RUBBER TILE.

Goodyear Tire & Rubber Co., The, Akron, O.
New York Belting & Packing Co., Ltd., 150 Lake St.

IRON DOORS AND SHUTTERS.

Central Iron Works of Chicago, 263-265 West Lake St.
Eastern Metal Works, 780 W. Chicago Av.
Eggers, John, Iron Works, 103 S. Canal St.
Halsted, Joseph, Co., 388 W. Randolph St.
Harris, S. H. Co., The, 29 Pearce St.
Kinnear Mfg. Co., The, 112 Clark St.
Muth, Chr., 428 Blue Island Av.
Ritter, E. W., & Co., 601 Monadnock Bldg.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.

Vierling, McDowell & Co., 23rd St. and Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.

IRON FOUNDRIES.

Reder Foundry Co., Canalport Av., Sangamon & Johnson Sts.

IRON RAILINGS AND FENCES.

American Bronze Foundry Co., 73rd and Woodlawn Ave.
American Iron & Wire Wks, 575-581 Carroll Av.
Bolters, A. Sons, 84 La Salle St.
Booth, John, 14 and 16 N. Canal St.
Brown Bros. Mfg. Co., 22d St. & Campbell Av.
Chicago Ornamental Iron Works, 37th St. and Stewart Av.
Eastern Metal Works, 780 W. Chicago Av.
Eggers, John, Iron Works, 103 S. Canal St.
Halsted, Joseph, Co., 388 W. Randolph St.
Holmes, Pyott & Co., 13 N. Jefferson St.
Muth, Chr., 428 Blue Island Av.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Smith, F. P. Wire & Iron Works, 100 Lake St.
South Halsted St. Iron Works, 135 Adams St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.
Standard Company, The, 810 Railway Exch.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.

IRON ROOFS.

Morava Construction Co., 1243 Marquette.
Muth, Chr., 428 Blue Island Av.
Scully Steel & Iron Co., Halsted and Fulton.
Strobel Steel Construction Co., 1744-1748 Monadnock Blk.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.

IRON SETTERS.

Volkman, Chas. & Co., 184 Dearborn St.

IRON STAIRS.

American Iron & Wire Wks, 575-581 Carroll Av.
Central Iron Works of Chicago, 263-265 West Lake St.
Chicago Ornamental Iron Works, 37th St. and Stewart Av.
Eastern Metal Works, 780 W. Chicago Av.
Eggers, John, Iron Works, 103 S. Canal St.
Halsted, Joseph, Co., 388 W. Randolph St.
Muth, Chr., 428 Blue Island Av.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.
Standard Company, The, 810 Railway Exch.
Vierling, McDowell & Co., 23rd St. and Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.
Winslow Bros. Co., The, W. Harrison St., 46th & 47th Aves.

IRON STORE FRONTS.

American Iron & Wire Wks, 575-581 Carroll Av.
Central Iron Works of Chicago, 263-265 West Lake St.
Chicago Ornamental Iron Works, 37th St. and Stewart Av.
Eastern Metal Works, 780 W. Chicago Av.
Halsted, Joseph, Co., 388 W. Randolph St.
Heath-Johnson Co., 127 E. Ontario St.
Muth, Chr., 428 Blue Island Av.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.
Standard Company, The, 810 Railway Exch.
Vierling, McDowell & Co., 23rd St. and Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.
Winslow Bros. Co., The, W. Harrison St., 46th & 47th Aves.

IRON WORK—ORNAMENTAL.

American Iron & Wire Wks, 575-581 Carroll Av.
Baldwin Brass Works, 232-234 S. Clinton St.
Bolters, A. Sons, 84 La Salle St.

Booth, John, 14 and 16 N. Canal St.
Brown Bros. Mfg. Co., 22d St. & Campbell Av.
Central Iron Works of Chicago, 263-265 West Lake St.
Chicago Ornamental Iron Works, 37th St. and Stewart Av.
Eastern Metal Works, 780 W. Chicago Av.
Eggers, John, Iron Works, 103 S. Canal St.
Halsted, Joseph, Co., 388 W. Randolph St.
Heath-Johnson Co., 127 E. Ontario St.
Holmes, Pyott & Co., 13 N. Jefferson St.
Muth, Chr., 428 Blue Island Av.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Smith, F. P. Wire & Iron Works, 100 Lake St.
South Halsted St. Iron Works, 135 Adams St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.
Standard Company, The, 810 Railway Exch.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.
Winslow Bros. Co., The, W. Harrison St., 46th & 47th Aves.

IRON WORK—STRUCTURAL.

Morava Construction Co., 1243 Marquette.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Smith, F. P. Wire & Iron Works, 100 Lake St.
Strobel Steel Construction Co., 1744-1748 Monadnock Blk.
Voss, Frederick, 617 to 621 Austin Av.

JAIL AND PRISON BUILDERS.

Bolters, A. Sons, 84 La Salle St.
Eastern Metal Works, 780 W. Chicago Av.
Halsted, Joseph, Co., 388 W. Randolph St.
Holmes, Pyott & Co., 13 N. Jefferson St.
Petersen, H. A., Mfg. Co., 407 Cham. of Com.
Smith, F. P. Wire & Iron Works, 100 Lake St.
South Halsted St. Iron Works, 135 Adams St.
Southwestern Architectural Iron Works, 734 Blue Island Ave.
Union Foundry Works, First Nat'l Bank Bldg.
Vierling, McDowell & Co., 23rd St. and Stewart Av.
Voss, Frederick, 617 to 621 Austin Av.

KALSOMINE.

Moore, Benjamin, & Co., 111-117 N. Green St.
Muralo Co., The, 24 Market St.
Rubber Paint Company, 150-156 W. Van Buren.

LAMPS—EXTERIOR—IRON AND BRONZE.

American Bronze Foundry Co., 73rd and Woodlawn Ave.
Brown Bros. Mfg. Co., 22nd St. and Campbell Av.
Chicago Ornamental Iron Works, 37th St. and Stewart Av.
Standard Company, The, 810 Ry. Exchange.

LATH

Hettler, Herman H., Lumber Co., 1324 Elston Av.

LATH—METAL AND WIRE.

Booth, John, 14 and 16 N. Canal St.
General Fireproofing Co., The, 315 Old Colony Bldg., Chicago; 212 Federal Bldg., Youngstown, Ohio.
Northwestern Expanded Metal Co., Old Colony Bldg.
Roebbling Construction Co., The, Stock Exchange Bldg.
Voss, Frederick, 617 to 621 Austin Av.
Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

LAUNDRY DRYERS.

Canton Clothes Dryer & Mfg. Co., Canton, O.
Chicago Dryer Co., 381 Wabash Ave.
Troy Laundry Machinery Co., 23rd and La Salle Sts.

LAUNDRY MACHINERY.

Canton Clothes Dryer & Mfg. Co., Canton, O.
Chicago Dryer Co., 381 Wabash Ave.
Dawson, A. L. & Co., 27-29-31 W. Washington.
Troy Laundry Machinery Co., 23rd and La Salle Sts.

LAUNDRY MACHINERY SUPPLIES.

Canton Clothes Dryer & Mfg. Co., Canton, O.
Troy Laundry Machinery Co., 23rd and La
Salle Sts.

**LAUNDRY TRAYS AND KITCHEN
SINKS.**

Alberene Stone Co., 56 N. Clinton St.

LETTER FILES.

Shaw-Walker Co., The, 151 Wabash Av.

LIABILITY INSURANCE.

Marsh & McLennan, 159 La Salle St.

LIBRARY FITTINGS AND FURNITURE.

Art Metal Construction Co., 135 Adams St.,
and Jamestown, N. Y.

Library Bureau, 156 Wabash Av.

Meleney, Geo. B., & Co., 1044 First National
Bank Bldg.

LIBRARY FURNITURE.

Library Bureau, 156 Wabash Av.

Meleney, Geo. B., & Co., 1044 First National
Bank Bldg.

LIME.

Builders' Material Co., 606 Cham. of Com.
Mecham & Wright, 308-09 Chamber of Com.
Knickerbocker Ice Co., 171 La Salle St.
Schultz, F., 658 S. Halsted St.
Wisconsin Lime & Cement Co., 607 Cham-
ber of Commerce.

LINK BELTING.

Brown Holsting Machinery Co., The, Cleve-
land, Ohio.

Jenrey Mfg. Co., Monadnock Bldg., and Colum-
art Av.

Webster Mfg. Co., 1075 W. 15th St.

LOANS.

Balrd & Warner, 90 La Salle St.
Greenebaum Sons, 59 Clark St.

LOCKERS—SHEET STEEL.

Churchill & Spalding, 464-478 Carroll Ave.

LOCKERS—VENTILATED.

Dodge, H. B. & Co., 525-108 La Salle St.

LUMBER.

Chandler Lumber Company, 100 Elston Av.
Hettler, Herman H. Lumber Co., 1324 Elston.
Mears, Slayton Lumber Co., 1103 Belmont
Ave.

Palne Lumber Co., Chamber of Commerce.

Pilsen Lumber Co., The, Laflin & 22d St.

Rittenhouse & Embree Co., 3500 Center Av.

Wilce, T. Co., The, 22nd and Throop Sts.

LUMBER—KILN DRIED.

Chandler Lumber Company, 100 Elston Av.
Pilsen Lumber Co., The, Laflin & 22d St.
Rittenhouse & Embree Co., 3500 Center Av.
Wilce, T. Co., The, 22nd and Throop Sts.

LUMBER—YELLOW PINE—LONG LEAF.

Hettler, Herman H. Lumber Co., 1324 Elston.
Pilsen Lumber Co., The, Laflin and 22d St.

MACHINISTS.

Contractors Supply & Equipment Co., Old Col-
ony Bldg.

Creamery Package Mfg. Co., The, 184 Kinzie
St.

Jackson, George W., Inc., 169-179 W. Jack-
son Blvd.

Jeffrey Mfg. Co., Monadnock Bldg., and Colum-
bus, Ohio.

Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Olson Brothers, 705 Bloomingdale Av.

Webster Mfg. Co., 1075 W. 15th St.

Weller Mfg. Co., 118 East North Ave.

Wolf, Fred W. Co., The, 139 Rees St.

York Mfg. Co., 1060 Monadnock Block.

**MACHINISTS' AND MANUFACTURERS'
SUPPLIES.**

Contractors Supply & Equipment Co., Old Col-
ony Bldg.

MANTELS.

Dawson Bros., 197-207 N. Halsted St.

MANTELS—WOOD, BRICK AND TILE.

Dawson Bros., 197-207 N. Halsted St.

MARBLE WORKERS AND DEALERS.

Caretti, John, & Co., 47 W. Lake St.

Dawson Bros., 197-207 N. Halsted St.

Marthens, Chester N., Marble Co., 53d and
Wallace Sts.

Sherman-Flavin Marble Co., 2505-2509 State
St.

MASON CONTRACTORS.

Alling Construction Co., 1507-8 Chicago Sav.
Bank Bldg.

Bulley & Andrews, 411, 115 Dearborn St.

Bushnell, Carl, 217 Cham. of Com.

Campbell, Arch. M., R. 23, 132 La Salle St.

Clark C. Everett Co., 1405, 100 Washington St.

Eilenberger, H., & Co., 153 La Salle St.

Erlisson, John & Henry, 84 La Salle St.

Ewen, John M., Co., The, The Rookery.

Freeman, Hart & Co., Chamber of Commerce.

Gindele, Chas. W., Co., 3333 La Salle St.

Grace, Wm. Company, 1408 Wabash Av.

Griffiths, John & Son, 1009-1011 Merchants
Loan & Trust Bldg.

Johnson, F. O., 84 La Salle St.

Lanquist & Illsley Co., 393 North Clark St.

Ledgerwood, A. J. C., Rooms 516-517, 184
La Salle St.

Lotz, Philip, 58 Wabash Av.

Mavor, William Co., 164 Dearborn St.

Melling & Walther, 84 La Salle St.

Morrice & Barron, 125 La Salle St.

Mortimer, Wm. H., 280 La Salle St.

Mueller, Carl R., Builders' & Traders' Ex-
change, Box 39.

Mueller, Paul P. F., 109 Randolph St.

Pittsburgh Construction Co., Diamond Bank
Bldg., Pittsburgh, Pa.

Rodatz, Jacob, The Rookery.

Schluter, Henry W., 204 Dearborn St.

Snyder, H. V., & Son, 1007 Security Bldg.

Snyder, J. W., Suite 1009-11, 160 Washing-
ton St.

Sollitt, Ralph, & Sumner Co., 612 Pullman
Bldg.

Strandberg, E. P. Company, 159 La Salle St.

Stresenreiter Bros., 614 Chamber of Commerce.

Swift, Geo. E., Company, 902-4 Security
Bldg., 188 Madison St.

Thompson-Starrett Co., Fisher Bldg.

Todd, James & Co., 145 La Salle St.

Warren Construction Co., The (Wm. H.
Warren, Prest.), Monadnock Bldg.

Wells Bros. Company, 1014 Monadnock Bldg.

Zadeck, B. M. Co., 811, 135 Adams St.

MAUSOLEUMS—GRANITE.

American Granite Co., 813 Chamber of Com-
merce Bldg.

METAL CEILINGS.

Canton Art Metal Co., The, Canton, Ohio.

Eller Mfg. Co., The, Canton, Ohio.

Illinois Metal Ceiling & Supply Co., 23 Lake
St.

Keighley, S., Metal Ceiling Mfg. Co., Pitts-
burgh, Pa.

Kuisey Bros., 28th Pl. and 5th Ave.

Sykes Steel Roofing Co., 112-120 W. 19th Pl.

Watson, W. D., Co., 302 W. Van Buren St.

METAL FURNITURE.

Art Metal Construction Co., 135 Adams St.,
and Jamestown, N. Y.

General Fireproofing Co., The, 315 Old Colony
Bldg., Chicago; 212 Federal Bldg., Youngs-
town, Ohio.

Krag Imperial Cabinet Co., 814-822 Fulton St.

METAL INTERIOR DECORATIONS.

Eller Mfg. Co., The, Canton, Ohio.

METAL LATH.

Brown Hoisting Machinery Co., The, Cleve-
land, O.

General Fireproofing Co., The, 315 Old Colony Bldg., Chicago; 212 Federal Bldg., Youngstown, Ohio.

Northwestern Expanded Metal Co., Old Colony Bldg.

Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

METAL SASH AND FRAMES.

Knisely Bros., 28th Place and 5th Av.
Voigtman & Company, 42-54 E. Erie St.
Watson, W. D., Co., 302 W. Van Buren St.

METAL SHINGLES.

Canton Art Metal Co., The, Canton, Ohio.

METAL TILE

Chicago Metile Co., 152 Lake St.

MILL WORK.

Brunton, Julius, 4013-17 Wentworth Av.
Mears, Slayton Lumber Co., 1103 Belmont Ave.

Morgan Sash & Door Co., Blue Island Av. and Wood St.

Nollau & Wolff Mfg. Co., 35-45 Fullerton Av.
Paine Lumber Co., Chamber of Commerce.

MILL AND ELEVATOR SUPPLIES.

Moore & Lorenz Co., 814-822 Fulton St.

MILL WORK—SASH, DOORS AND BLINDS.

American Compound Door Co., 21st and Morgan St.

Chicago Veneered Door Co., 316 Chamber of Commerce Bldg.

Mears, Slayton Lumber Co., 1103 Belmont Ave.

MINERAL WOOL.

Chicago Fire Proof Covering Co., 173 Randolph St.

Sall Mountain Asbestos Mfg. Co., 70 S. Canal St.

Stowell Mfg. Co., 47 Market St.
Watson, H. F. Co., 12-14 S. Clinton St.
Western Roofing & Supply Co., 177 Randolph St.

MODEL MAKERS.

Rabe, Otto, 16 N. Desplaines St.

MONUMENTS.

American Granite Co., 813 Chamber of Commerce Bldg.

MORTAR COLORS.

Chicago Hydraulic Press Brick Co., 3rd Floor Chamber of Commerce Bldg.

Kimbell, S. S., Brick Co., 304 Cham. of Com.
Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

MORTGAGE LOANS.

Baird & Warner, 90 La Salle St.

Greenebaum Sons, 59 Clark St.

MOSAICS.

Caretti, John, & Co., 47 W. Lake St.
Marthens, Chester N., Marble Co., 53d and Wallace Sts.

Sherman-Flavin Marble Co., 2505-2509 State St.

Weary & Beck, Suite 634 First Nat'l Bk. Bldg.

MOULDINGS.

Brunton, Julius, 4013-17 Wentworth Av.
Hettler, Herman H. Lumber Co., 1324 Elston.

Mears, Slayton Lumber Co., 1103 Belmont Ave.

Moore, Geo. F., 186-188-190 24th St.
Morgan Sash & Door Co., Blue Island Av. and Wood St.

Nollau & Wolff Mfg. Co., 35-45 Fullerton Av.
Paine Lumber Co., Chamber of Commerce.

MOULDINGS—DECORATIVE.

Moore, Geo. F., 186-188-190 24th St.

MOULDINGS—INTERIOR.

Moore, Geo. F., 186-188-190 24th St.

MOULDINGS—ROOM.

Moore, Geo. F., 186-188-190 24th St.

MURAL PAINTINGS.

Carpenter, Geo. M., & Co., 1543 Leland Ave.

NATURAL GAS FITTING.

Nacey, P. Co., 315-317 Wabash Av.

OFFICE FITTINGS.

Baumann F. O. Mfg. Co., Blackhawk St. and Smith Ave.

OFFICE FIXTURES.

Chicago Bank & Office Fixture Co., 677-679 W. Van Buren St.

OFFICE FURNITURE.

Andrews, A. H. Co., The, 174-176 Wabash.

OFFICE FITTINGS AND FURNITURE.

Art Metal Construction Co., 135 Adams St. and Jamestown, N. Y.

Shaw-Walker Co., The, 151 Wabash Av.

Library Bureau, 156 Wabash Av.

Meleney, Geo. B., & Co., 1044 First National Bank Bldg.

ORNAMENTAL IRON BANK AND OFFICE FIXTURES.

American Bronze Foundry Co., 73rd and Woodlawn Ave.

Chicago Ornamental Iron Works, 37th St. and Stewart Av.

Eggers, John, Iron Works, 103 S. Canal St.
Smith, F. P. Wire & Iron Works, 100 Lake St.

Standard Company, The, 810 Ry. Exchange.

ORNAMENTAL PATTERNS FOR METAL CASTINGS.

Dux, Joseph, 132 W. Jackson Blvd.

ORNAMENTAL TERRA COTTA.

American Terra Cotta & Ceramic Co., The, 602 Chamber of Commerce Bldg.

Northwestern Terra Cotta Co., The, 1415 Railway Exchange Bldg.

PACKING.

Jenkins Bros., 31 North Canal St.

PAINT—GRAPHITE.

Lucas, John, & Co., 200 S. Morgan St.

Pitkin, Geo. W. Co., Fulton & Carpenter Sts.

Rubber Paint Company, 150-156 W. Van Buren.

PAINT—IRON.

Garden City Sand Co., The, 188 Madison St.

Lucas, John, & Co., 200 S. Morgan St.

Pitkin, Geo. W. Co., Fulton & Carpenter Sts.

Rubber Paint Company, 150-156 W. Van Buren.

PAINT MILLS AND MACHINERY.

Kaestner, Chas. & Co., 241-261 S. Jefferson St.

PAINT—MIXED.

Lucas, John, & Co., 200 S. Morgan St.

Muralo Co., The, 24 Market St.

Pitkin, Geo. W. Co., Fulton & Carpenter Sts.

Rubber Paint Company, 150-156 W. Van Buren.

PAINTERS' SUPPLIES.

Lucas, John, & Co., 200 S. Morgan St.

Muralo Co., The, 24 Market St.

Pitkin, Geo. W. Co., Fulton & Carpenter Sts.

Rubber Paint Company, 154-156 W. Van Buren.

PAINTS.

Lucas, John, & Co., 200 S. Morgan St.

Moore, Benjamin, & Co., 111-117 N. Green St.

Muralo Co., The, 24 Market St.

Pitkin, Geo. W. Co., Fulton & Carpenter Sts.

Royal Crown Lead Co., Detroit, Mich.

Rubber Paint Company, 150-156 W. Van Buren.

PAINTS—COLD WATER.

Chicago Fire Proof Covering Co., 173 Randolph St.

Johns-Manville Co. H. W., 173 Randolph St.

Lucas, John, & Co., 200 S. Morgan St.

Muralo Co., The, 24 Market St.

Pitkin, Geo. W. Co., Fulton & Carpenter Sts.

Rubber Paint Company, 150-156 W. Van Buren.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

PAINTS-DAMP PROOFING.

Toch Bros., 320 Fifth Av.

PAINTS-DAMP RESISTING.

Garden City Sand Co., The, 188 Madison St.
Toch Bros., 320 Fifth Av.

PAINT-ENAMEL.

Royal Crown Lead Co., Detroit, Mich.

PAINTS-FIREPROOF.

Muralo Co., The, 24 Market St.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.

PAINTS-ROOFING.

Chicago Fire Proof Covering Co., 173 Ran-
dolph St.
Lucas, John, & Co., 200 S. Morgan St.
Muralo Co., The, 24 Market St.
Pitkin, Geo. W. Co., Fulton & Carpenter Sts.
Rubber Paint Company, 150-156 W. Van Buren.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.
Stowell Mfg. Co., 47 Market St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

PARQUET FLOORS.

Dunfee, J., & Co., 104-106 Franklin St.
Newcomb, E. R., 14 E. Monroe St.

PATTERN MAKERS.

Rabe, Otto, 16 N. Desplaines St.

PAVING BLOCKS-GRANITE.

American Granite Co., 813 Chamber of Com-
merce Bldg.

PAVING CONTRACTORS.

Citizens Construction Co., 805-6 Chamber of
Commerce Bldg.

PHYSICAL LABORATORY.

Hunt, Robert W. & Co., 1121 The Rookery.

PILING-CONCRETE

Raymond Concrete Pile Co., 135 Adams St.

PIPE AND BOILER COVERING.

Chicago Fire Proof Covering Co., 173 Ran-
dolph St.
Garden City Sand Co., The, 188 Madison St.
Johns-Manville Co., H. W., 173 Randolph St.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.
Watson, H. F. Co., 12-14 S. Clinton St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

PLASTER.

Architectural Decorating Co., 643 S. Jefferson.
Builders & Decorators Mfg. Co., 554 N. Hal-
sted St.
Decorators' Supply Co., The, Archer Av. &
Leo St.
Jenkins & Reynolds Co., The, 1210 Chamber
of Commerce.

PLASTER, ORNAMENTAL.

Architectural Decorating Co., 643 S. Jefferson.
Builders & Decorators Mfg. Co., 554 N. Hal-
sted St.
Decorators' Supply Co., The, Archer Av. &
Leo St.

PLASTERING.

Dorothy, William H., 314 Ashland Bldg.
Lennox-Haldeman Co., 747 Marquette Bldg.
McNulty Bros., 1455 Railway Exchange Bldg.
Zander-Reum Co., 508 Lakeside Bldg.

PLASTERING CONTRACTORS.

Dorothy, William H., 314 Ashland Bldg.
Lennox-Haldeman Co., 747 Marquette Bldg.
McNulty Bros., 1455 Railway Exchange Bldg.
Zander-Reum Co., 508 Lakeside Bldg.

PLASTERING LATH.

Brown Holsting Machinery Co., The, Clevel-
land, O.
General Fireproofing Co., The, 315 Old Colony
Bldg., Chicago; 212 Federal Bldg., Youngs-
town, Ohio.
Roebeling Construction Co., The, Stock Ex-
change Bldg.
Voss, Frederick, 617 to 621 Austin Av.

PLASTERING MATERIAL.

Garden City Sand Co., The, 188 Madison St.
Jenkins & Reynolds Co., The, 1210 Chamber
of Commerce.
Michigan Plaster Co., 637-641 The Rookery.
United States Gypsum Co., 200 Monroe St.
Wisconsin Lime & Cement Co., 607 Cham-
ber of Commerce.

PLASTIC RELIEF.

Architectural Decorating Co., 643 S. Jefferson.
Builders & Decorators Mfg. Co., 554 N. Hal-
sted St.
Decorators' Supply Co., The, Archer Av. &
Leo St.
Hartmann, John, 13 N. Jefferson St.
Weary & Beck, Suite 634 First Nat'l Bk. Bldg.

PLUMBING, GASFITTING AND SEWER- AGE.

Donat Co., J. L., The, 1123-1125 S. Spaulding
Av.
Nacey, P. Co., 315-317 Wabash Av.
Nilson Bros., 1463 Belmont Av.
Noble & Thumm, 292 Lincoln Av.

PORTLAND CEMENT.

Garden City Sand Co., The, 188 Madison St.
Knickerbocker Ice Co., 171 La Salle St.

POST CAPS.

Columbian Hardware Co., The, 45 E. Lake St.

POWER GENERATORS.

Fairbanks, Morse & Co., Franklin and Monroe.
Street, R. R. & Co., 184-186 Washington St.

POWER PLANTS.

Crane, M. H. Estate, 609 Security Bldg.
Graves, W. B., Co., 121 Kinzie St.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.

POWER PUMPS.

Rider-Ericsson Engine Co., 40 Dearborn St.

POWER TRANSMISSION APPLIANCE.

Street, R. R. & Co., 184-186 Washington St.

PREPARED ROOFING MATERIAL.

Chicago Fire Proof Covering Co., 173 Ran-
dolph St.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

PRESSURE HEATING.

Davis, G. M. Regulator Co., 144-146 Milwau-
kee Av.

PRISMATIC LIGHTS.

Ritter, E. W., & Co., 601 Monadnock Blk.

PULLEYS-STEEL.

Street, R. R. & Co., 184-186 Washington St.

PUMPING MACHINERY.

Kehm Bros. Co., 226 E. Kinzie St.
Rider-Ericsson Engine Co., 40 Dearborn St.

PUMPS.

Dawson, A. L. & Co., 27-29-31 W. Washington.
Fairbanks, Morse & Co., Franklin and Monroe.
Kroeschell Bros. Co., 55 Erie St.
Rider-Ericsson Engine Co., 40 Dearborn St.

PUMPS-AUTOMATIC AND HYDRAULIC.

Kehm Bros. Co., 226 E. Kinzie St.
Murphy-Dugger-Clark Co., 19 N. Clark St.
Rider-Ericsson Engine Co., 40 Dearborn St.

PURIFIERS-WATER.

Loomis-Manning Filter Co., 826 Land Title
Bldg., Pittsburgh, Pa.

RADIATORS.

Arcade Steam Heating Co., 70 La Salle Av.
Kroeschell Bros. Co., 55 Erie St.
Murphy-Dugger-Clark Co., 19 N. Clark St.
Western Valve Co., 179 Lake St.

RAILINGS AND GRILLES—BRASS.

American Bronze Foundry Co., 73rd and
Woodlawn Ave.
Brown Bros. Mfg. Co., 22d St. & Campbell
Av.
Heath-Johnson Co., 127 E. Ontario St.
Standard Company, The, 810 Ry. Exchange.
Weary & Beck, Suite 634 First Nat'l Bk. Bldg.

RAILROAD SHOPS AND WAREHOUSES.

Pittsburgh Construction Co., Diamond Bank
Bldg., Pittsburgh, Pa.

REAL ESTATE LOANS.

Baird & Warner, 90 La Salle St.
Greenebaum Sons, 59 Clark St.

REFRIGERATING AND ICE MAKING MACHINERY.

Creamery Package Mfg. Co., The, 184 Kinzie
St.
Kroeschell Bros. Co., 55 Erie St.
Vilter Mfg. Co., The, Milwaukee, Wis., and
Monadnock Bldg., Chicago.
Wolf, Fred W. Co., The, 139 Rees St.

REFRIGERATORS.

McCray Refrigerator Co., 55 Wabash Ave., Chi-
cago; Kendallville, Ind.
Orr & Lockett Hardware Co., 71-73 Randolph.

REFRIGERATORS—HOTEL.

Creamery Package Mfg. Co., The, 184 Kinzie
St.

REGISTERS—WARM AIR.

Columbian Hardware Co., The, 45 E. Lake St.

REGULATORS—DAMPER.

Davis, G. M. Regulator Co., 144-146 Milwau-
kee Av.
Norwall Mfg. Co., 154 Lake St.

REGULATORS—HEAT, STEAM, AIR, WATER.

Davis, G. M. Regulator Co., 144-146 Milwau-
kee Av.
Johnson Service Co., 93 Lake St.
Powers Regulator Co., The, 40 Dearborn St.
Western Kieley Specialty Co., 112 E. Lake St.

REINFORCED CONCRETE CONSTRU- TION.

American Concrete Steel Co., Penobscot
Bldg., Detroit, Mich.
Brown & Read, 1212 Hartford Bldg.
Condron & Sinks Co., 1441 Monadnock Bldg.
Expanded Metal & Corrugated Bar Co., St.
Louis, Mo.
Hoeffer & Co., Cham. of Com.
Trussed Concrete Steel Co., The, Bedford
Bldg., 215 Dearborn St.

ROLLING PARTITIONS.

Dodge, H. B., & Co., 525, 108 La Salle St.

ROLLING PARTITIONS—WOOD AND STEEL.

Dodge, H. B. & Co., 525, 108 La Salle St.

ROOFING.

Brown Hoisting Machinery Co., The, Cleve-
land, O.
Eller Mfg. Co., The, Canton, Ohio.
Ford Roofing Co., 109 W. Washington St.
Illinois Roofing & Cornice Co., 319 W. Kinzie
St.
Johns-Manville Co., H. W., 173 Randolph St.
Knisely Co., Harry C., 273 S. Canal St.
National Roofing Co., 3223 La Salle St.
Powell, M. W. Co., 204 Dearborn St.
Standard Roofing Co., 290-294 N. Halsted St.
Voigtmann, Frank, Cornice Co., 129 N. Frank-
lin St.

ROOFING—ASBESTOS.

Chicago Fire Proof Covering Co., 173 Ran-
dolph St.
Johns-Manville Co., H. W., 173 Randolph St.
Sall Mountain Asbestos Mfg. Co., 70 S. Canal
St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

ROOFING—CORRUGATED IRON.

Illinois Roofing & Cornice Co., 319 W. Kinzie
St.
Knisely Bros., 28th Place and 5th Av.
Knisely Co., Harry C., 273 S. Canal St.
McFarland, J. C. & Co., 27th St. and 5th Av.
Scully Steel & Iron Co., Halsted and Fulton.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.
Voigtmann, Frank, Cornice Co., 129 N. Frank-
lin St.
Watson, W. D., Co., 302 W. Van Buren St.

ROOFING—GENERAL.

Ford Roofing Co., 109 W. Washington St.
National Roofing Co., 3223 La Salle St.
Powell, M. W. Co., 204 Dearborn St.
Standard Roofing Co., 290-294 N. Halsted St.

ROOFING—GRAVEL.

Ford Roofing Co., 109 W. Washington St.
National Roofing Co., 3223 La Salle St.
Powell, M. W. Co., 204 Dearborn St.
Standard Roofing Co., 290-294 N. Halsted St.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.

ROOFING MATERIALS.

Ford Roofing Co., 109 W. Washington St.
Garden City Sand Co., The, 188 Madison St.
Johns-Manville Co., H. W., 173 Randolph St.
National Roofing Co., 3223 La Salle St.
Powell, M. W. Co., 204 Dearborn St.
Standard Roofing Co., 290-294 N. Halsted St.
Stowell Mfg. Co., 47 Market St.
Watson, H. F. Co., 12-14 S. Clinton St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

ROOFING PAINTS.

Johns-Manville Co., H. W., 173 Randolph St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

ROOFING PAPER.

Ford Roofing Co., 109 W. Washington St.
Johns-Manville Co., H. W., 173 Randolph St.
Stowell Mfg. Co., 47 Market St.
Watson, H. F. Co., 12-14 S. Clinton St.
Western Roofing & Supply Co., 177 Ran-
dolph St.

ROOFING—SLATE AND TILE.

Illinois Roofing & Cornice Co., 319 W. Kinzie
St.
Knisely Co., Harry C., 273 S. Canal St.
McFarland, J. C. & Co., 27th St. and 5th Av.
Voigtmann, Frank, Cornice Co., 129 N. Frank-
lin St.

ROOFING TIN.

American Sheet & Tin Plate Co., Pittsburg,
Pa.; First Nat'l Bank Bldg., Chicago, Ill.;
Union Trust Bldg., Cincinnati, O.; Equi-
table Bldg., Denver, Colo.; Penobscot Bldg.,
Detroit, Mich.; Hennen Bldg., New Or-
leans, La.; Battery Park Bldg., New York
City; Pennsylvania Bldg., Philadelphia,
Pa.; Ainsworth Block, Portland, Ore.;
Union Trust Bldg., San Francisco, Cal.;
Chemical Bldg., St. Louis, Mo.
Osborn, J. M. & L. A., Co., The, Cleveland, O.

ROOFING—TIN, SLATE, TILE AND METAL.

Illinois Roofing & Cornice Co., 319 W. Kinzie
St.
Knisely Bros., 28th Place and 5th Av.
Knisely Co., Harry C., 273 S. Canal St.
Sykes Steel Roofing Co., 112-120 W. 19th Pl.
Watson, W. D., Co., 302 W. Van Buren St.

ROOM MOLDINGS.

Moore, George F., 186-188-190 24th St.

ROPES.

Macomber & Whyte Rope Co., 266-268 S. Clinton St.

ROPE TRANSMISSION MACHINERY.

Jeffrey Mfg. Co., Monadnock Bldg., and Columbus, Ohio.
Kaestner, Chas. & Co., 241-261 S. Jefferson St.
Olson Brothers, 705 Bloomingdale Av.
Webster Mfg. Co., 1075 W. 15th St.
Weller Mfg. Co., 118 East North Ave.

RUBBER GOODS.

Gutta Percha & Rubber Mfg. Co., 224 E. Randolph St.

RUBBER-MOULDED.

Goodyear Tire & Rubber Co., The, Akron, O.

RUBBER TILE.

Goodyear Tire & Rubber Co., The, Akron, O.
New York Belting & Packing Co., Ltd., 150 Lake St.

RUBBER TILING-FLOORS FOR ELEVATORS AND PUBLIC PLACES.

Goodyear Tire & Rubber Co., The, Akron, O.
Gutta Percha & Rubber Mfg. Co., 224 E. Randolph St.
New York Belting & Packing Co., Ltd., 150 Lake St.

SAFES.

Donnell Safe Co., 200 Washington St.
Harris, S. H. Co., The, 29 Pearce St.

SAFES-BANK.

Donnell Safe Co., 200 Washington St.
Harris, S. H. Co., The, 29 Pearce St.

SAFES-WALL.

Gross, H. H., & Son, 1328 First Nat'l Bank Bldg.

SAFETY DEPOSIT VAULTS.

Chamber of Commerce Safety Vault Co., Chamber of Commerce, 132 Washington St.

SAND.

American Sand & Gravel Co., 907 Cham. of Com. Bldg.
Builders' Material Co., 606 Cham. of Com.
Garden City Sand Co., The, 188 Madison St.
Knickerbocker Ice Co., 171 La Salle St.
Krug, S., 167 Dearborn St.
Wisconsin Lime & Cement Co., 607 Chamber of Commerce.

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American Sand & Gravel Co., 907 Cham. of Com. Bldg.
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Knickerbocker Ice Co., 171 La Salle St.

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Samson Cordage Works, 115 Congress St., Boston, Mass.

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Mears, Slayton Lumber Co., 1103 Belmont Ave.
Morgan Sash & Door Co., Blue Island Av. and Wood St.
Nollau & Wolff Mfg. Co., 35-45 Fullerton Ave.
Paine Lumber Co., Chamber of Commerce.

SCALES.

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Cabot, Samuel, 28 Dearborn Ave. and Boston, Mass.

Johns-Manville Co., H. W., 173 Randolph St.
Stowell Mfg. Co., 47 Market St.
Watson, H. F. Co., 12-14 S. Clinton St.
Western Roofing & Supply Co., 177 Randolph St.

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Hettler, Herman H. Lumber Co., 1324 Elston.

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Lucas, John, & Co., 200 S. Morgan St.

SHOW CASE BARS.

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Brown, F. E., & Co., 215 Dearborn St.
de Smet, Geo. W., Chamber of Commerce.
Hoeffer & Co., Chamber of Commerce Bldg.
Schillinger Bros. Co., 1181 N. Seeley Av.
Simpson Construction Co., 704 Cham. of Com.

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Brown Bros. Mfg. Co., 22d St. & Campbell Av.
Ritter, E. W., & Co., 601 Monadnock Bldg.

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Eller Mfg. Co., The, Canton, Ohio.
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Standard Company, The, 810 Ry. Exchange.

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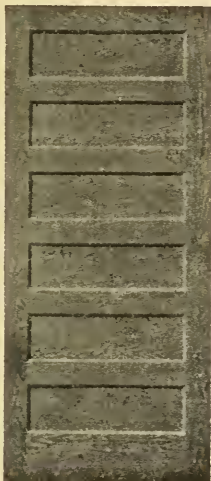
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